THE AMERICAN GAS LIGHT JOURNAL

PUBLISHING OFFICE No. 42 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LI.—No. 13. Whole No. 746. | NEW YORK, MONDAY, SEPTEMBER 23, 1889. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y. AS SECOND CLASS MATTER.

Published on each Monday of the year, at No. 42 Pine Street, N.Y.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $4.00 (17 shillings—20 francs). All payments to be made in advance. Single copies, 10 cents.

Remittances should be made either by post-office order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

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[OFFICIAL NOTICE.]

Annual Meeting, American Gas Light Association.

LAWRENCE, MASS., Sept. 11, 1889.

Section 12 of the Constitution is as follows:

"Section 12. *Application for Active Membership, or for Associate Membership, or for transfer from Associate to Active Membership, must be received by the Secretary at least ten days prior to the meeting at which the application is acted on.*"

To the Members of the Association: Gentlemen—As already announced, the Seventeenth Annual Meeting of the Association will be held at Baltimore, Md., on Wednesday, Thursday, and Friday, Oct. 16, 17, and 18. The headquarters of the Association will be at the Carrollton Hotel, which is conducted on the American plan. The meetings of the Association will be held in the Concert Hall of the Concordia Building, on German street near Eutaw.

As, in my circulars of July 29, I had considerable to say in the way of impressing upon members the necessity of procuring rooms in advance at the hotel, it is not necessary for me to say much on this point now. I would merely add, as a reminder, that the rate at the Carrollton is $3 per day, and if the members take the pains to write in advance for rooms they will all be taken care of.

I am assured by the Committee that the hall selected for the meetings of the convention is in all respects a desirable place. Certainly this is a good cause for rejoicing, because a suitable hall adds greatly to the pleasure of the meeting.

The Council has appointed the following gentlemen as the Committee to nominate officers for the ensuing year, namely: Chas. H. Nettleton, Birmingham, Conn.; Edward Lindsley, Cleveland, Ohio; D. H. Geggie, Quebec, Canada; Geo. S. Hookey, Augusta, Ga.; Ed. G. Cowdery, Milwaukee, Wis. Members who desire to see the names of any particular persons nominated for officers should make their preferences known to the members of the Committee.

I am requested to state that special arrangements will be made at Baltimore for the entertainment of ladies accompanying members to the meeting.

There is no change in the literary part of the programme, which is as follows:

"Fuel Gas," by Walton Clark.

"Gas Coals of the United States," by H. C. Adams.

"Care and Operation of Gasholders," by C. L. Rowland.

"Illuminating Water Gas—Past and Present," by F. H. Shelton.

"Leakage and Condensation," by E. C. Jones.

"Purification of Gas from Kansas Coals," by B. E. Chollar.

"Conduct of the Electric Light Business in Connection with the Gas Industry," by W. H. Pearson.

"Advantages of Supplying a Mixture of Coal and Water Gas," by T. G. Lansden.

"Some Thoughts on Fuel Gas, Induced from Practical Experience in the Distribution of Natural Gas," by John Young.

"Gas Calorimetry," by Prof. E. G. Love.

No particular effort has been made to add to the number of papers

during the last month, as it is thought that to thoroughly digest these dissertations will take up all the time of the meeting. I have the following conundrums for the Question-Box:

"Is it wise to make a special discount on gas used for cooking and heating?"

"Is the scheme of introducing air into gas for the purpose of reviving the iron a success?"

"What progress has been made this year in the matter of regenerative furnaces?"

"How shall firebricks and tiles be laid, wet or dry?"

"What composition of gas will give the highest illuminating power when burned with a common fishtail burner burning 5 feet per hour, and convert all of the carbon into CO_2?"

"What specific gravity of oil will yield the greatest amount of gas with the highest illuminating power?"

"What chemical change takes place when a liquid hydrocarbon is exposed to a high temperature and made into a permanent illuminating gas?"

If the members have any other questions for the box I would suggest that they be sent along as promptly as possible.

It has also been suggested to me that if I remind the members that there are four water gas processes in operation in Baltimore, the fact may serve as an extra reason why the members should strive to be present at the forthcoming meeting, as they will have the opportunity to examine these processes side by side, and thus be the more able to determine the value of each.

It is expected that the proper disposal of this programme in the allotted two days will be just sufficient tax on the energies of the members to make the relaxation of Thursday evening and Friday all the more enjoyable.

On the evening mentioned—the second of the meeting—the Association will be tendered a dinner by the Messrs. Bartlett, Hayward & Co. On Friday the Association will enjoy a sail down the beautiful bay, stopping at points of interest, and during the trip the members will be the guests of the Maryland Meter and Manufacturing Company. An inspection will also be made of the Chesapeake gas works, when we will be in the hands of the officers of the Consolidated Gas Company.

To the foregoing it is hardly necessary to add that the Baltimore meeting bids fair to be a profitable and enjoyable one. Each member should make strenuous effort to be present at the meeting.

I am now endeavoring to secure reduced railroad rates for the members attending the convention; a special circular on this subject will be issued to the members in a very few days. Those who are not now members of the Association and are intending to be present at the meeting should apply to the Secretary for a copy of the Transportation Circular. Yours truly, C. J. R. Humphreys.

BRIEFLY TOLD.

Additions to the Programme.—The current circular of Secretary Humphreys discloses the fact that a healthy interest is being taken in the preliminaries for the Baltimore meeting, and that the members are arming themselves for the fray. It is with no little gratification that we welcome the enrollment of the name of Prof. E. G. Love, of this city, on the paper list, and we congratulate the Association and himself on the well-chosen subject that he is to speak to. Gas calorimetry proper has not been discussed, at least as far as we are aware, before any of our Association gatherings in the past, and it is reassuring to know that the subject is to be introduced to the American Association by an author so well versed in all its delicate details. Prof. Love's discourse is certain to be scholarly and instructive. Another change that will be detected in the arrangement of the paper list is that concerning the title of the essay to be read by Mr. F. H. Shelton. This gentleman had promised to speak on the subject of "Water Gas," but the understanding now is that his remarks are to come under the head, "Illuminating Water Gas—Past and Present." This change is more literal than real. Three questions have also been added to the list for the question-box; and we submit that any one of the three could be counted on to lead to an interesting discussion. Judging from the remarks that are made in our hearing respecting the Baltimore gathering, the latter is bound to be an unqualified success. It is possible that the Eastern delegation—*i. e.*, members resident east of the State of Connecticut—will travel through from Boston, by way of the New York and New England and the Pennsylvania Railroad, in special car, leaving that city on the evening of Monday, October 14. The arrangements in this regard, however, will be published in ample season.

Annual Report, Department of Public Works, Philadelphia, Pa.—We herewith acknowledge the receipt of a copy of the second annual report of the Department of Public Works, of Philadelphia, and we offer our congratulations to Director Wagner on the good style in which he has collated and printed the statistics for the year relative to the working of the Bureaus over which he has charge. Of course, it is with the report of Chief W. K. Park, of the Bureau of Gas, that our greatest sympathies are, and it is pleasurable at the outset of our excerpts from these records to say that the Chief has not been unsuccessful in his efforts to better the results of the plant under his charge. At the outset, it should be remarked that the returns are for the twelvemonth ended December 31, 1888. In the first place, we note a slight increase in the yield of gas per pound of coal carbonized—4.697 in '87, against 4.701 in '88. The average illuminating power of the gas distributed is returned at 18.54 candles. The leakage account was slightly increased, but this is explained on the ground of the extensions to the main system—39½ miles of pipes were laid, and of this length over 16 miles were from 8-inch to 20-inch diameters—with the temporary waste that comes from such work. During the year the increase in the quantity of gas made was but 1.74 per cent., and Chief Park advances two reasons for this woeful falling away from the normal increase of gas consumption in the city. First of all, he thinks the competition of the electric light had a potent influence on gas sales; second—and a queer reason it undoubtedly is, although beyond question a good one—the failure of the authorities to renew the licenses of something like 5,000 saloon keepers. The new license laws of the Quaker City, therefore, seem to have accomplished much of the design that actuated their formation. But while the gas consumption rate did not keep up to that of former years, it is nevertheless true that the profit earned from the operation of the works in the twelvemonth was about 14 per cent. in excess of the corresponding period in 1887—the total quantity of gas manufactured in the plant was 3,209,874,000 cubic feet. It is easy, however, to account for the large increase in profit, because the Chief had, by his persistence, induced his superiors to authorize an extensive system of betterments, such as improved benches, added storage capacity, Ross stoking machines, new exhausters, increased purifying capacity, an auxiliary water gas plant, the substitution of iron sponge for lime as a purifying material, etc. It should be said further that the effect of these improvements covers only a part of the year under review, in that some of the betterments were not completed fixtures until well along in the year. The daily average production of gas was 8,770,147 cubic feet; the greatest make in 24 hours was on December 24 (13,191,000 cubic feet), the greatest consumption (14,454,000) also being reported on that day. The Chief notes that the Ross machines were performing their work satisfactorily, and that an equal result was being obtained from the new Wilbraham exhausters. The Chief also reports favorably in respect to the use of sponge as the purifying material. We would like to give more of the details of the working of Philadelphia's huge gas manufacturing establishment, but the above outlines will be sufficient to show that good progress has been made by Director Wagner and Chief Park. Further, that the progress thus recorded for '88 is but a trifling showing when its figures shall have been placed in comparison with those that have been and are to be made for the year now drawing to a close.

Some days ago a correspondent of the Chicago *Inter-Ocean*, evidently in a moment of wrath, indicted an epistle to that paper in which he charged that "For at least three weeks the larger part of State street viaduct as far as Kinzie street has been perfectly dark at night." The careful editor of the *Inter-Ocean* applied to City Gas Inspector Schofield for confirmation respecting the charge—the portion of the viaduct complained of is illuminated by gas lamps—and that official flatly said the statement could not be true, as he (the Inspector) had frequently driven over the viaduct during the times specified in the charge, and he always found all the lights in proper order. The Inspector concluded by remarking that the real cause for complaint was the insufficiency of the number of lights maintained by the city at this point—that the lamps were too far apart. It is only the old story over again of expecting to secure something for nothing.

Disaster has overtaken the Cornwall (Canada) Gas Light Company. The plant and franchises which were offered at auction by the boudholders were bought in by the latter, and well-informed persons predict that the future of the Company is bound to be anything but a successful one. The Fahnehjelm process was given a fair trial at this point, and its failure there was complete.

The proceedings of the Society of Gas Lighting (1885-6-7-8) have just been published. The book is quite a handsome one.

[A Paper read before the Society of Gas Lighting.]

Laying Gas Mains Under Water.

By Eugene Vanderpool.

It became necessary this year for the East Newark Gas Light Company either to extend its works, or obtain its supply of gas from the Newark Gas Light Company.

The latter method was considered to be better and less costly, and it was determined to put down under the bed of the Passaic river, which at Newark separates the counties of Essex and Hudson, two lines of pipe 12 inches in diameter.

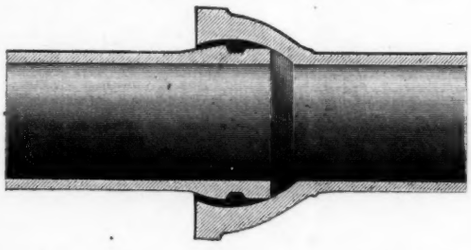
A survey of the bed of the river showed that the depth of the water at low tide was 12 feet on the Newark side of the river, while at the bulkhead line on the East Newark side the banks were exposed.

This is clearly shown by the profile which is herewith submitted.

It was thought best to dredge a trench in the bottom of the river, so as to place the pipes at a depth so great that they would not be interfered with by the future improvements in deepening the channel contemplated by the government. It became necessary, therefore, to put down the pipes so that their upper portion would at no point, for a distance of 240 feet from the Newark dock line, be less than 12½ feet below low water line, and the balance of the pipe, between the bulkhead lines, not less than 10½ feet deep.

In the prosecution of the work the depth has been increased, and the pipes all laid at no point in the above described distance of 240 feet less than 15 feet deep, and the balance of the pipe has a depth of 13 feet below low water line. An examination of the bottom of the river showed that it would be necessary to dredge a trench from 4 to 15 feet deep below the bed, and as the material to be moved consisted of mud and sand, it was feared that the pipes would have to be laid at once after the dredgers had completed a trench, say, 100 feet in length, as the banks of the trench would probably cave in, and the silt carried by the stream would also rapidly fill it up.

This examination of the river bottom determined the description of the pipes to be put down, and it was concluded to adopt cast iron pipes with a ball and socket joint, the invention of Mr. John F. Ward.



You will observe by the drawing that the pipe joint consists of a socket that has been carefully bored out, and that the spigot end has a deep groove cast entirely around it.

The joint is made by inserting the spigot and then pouring into the socket soft lead.

The result is a ball and socket joint of much flexibility and considerable tightness, that can be made absolutely tight by caulking after the pipe has been placed in position.

It was found after the river bed had been dredged to the necessary depth that the trench remained comparatively clear. There was but little caving in, and the silt from the stream did not fill in rapidly.

Consequently the trench was completely dug before the pipe laying was begun.

You will notice, by the drawings submitted, that the distance across the river is 600 feet, that the pipe is laid on a grade that will carry all the condensation to the Newark side of the river where it is received into the drips formed by the 24-inch stand-pipes.

The 24-inch stand-pipes render it possible to reach the 12-inch pipe for inspection, etc.

We first attempted to lay the 12-inch pipes from the Newark side of the river, but the depth was so great that the angle made between the barge from which the pipes were laid and the bottom of the 24-inch pipe brought a greater strain on the joints than the metal could withstand, and the iron end of the spigot striking the metal of the socket would break the pipe.

Consequently this method of laying the pipes was abandoned, and the pipes were jointed on the East Newark side of the river, and then by means of a steel cable 2 inches in diameter, attached to the spigot end of one of the pipes, they were dragged across the river.

A windlass on the Newark side gave a traction equal to about 10 tons, and the pipes were moved slowly and easily to their bed. The flange joints connecting the 12-inch to the 24-inch pipes were made by a diver.

After the pipes had been dragged over they were laid to the grade shown in the plan as follows:

A 15-horse power boiler was placed on a barge and attached to a powerful steam pump, and the pump delivered to the diver, by means of a rubber hose, a strong stream of water.

Where the pipes were above grade the diver, by the use of the stream of water, washed out the sand under the pipes and they settled back to their proper position.

Where the pipes were too low they were raised by suitable tackle, and the diver placed under them broken stones and pieces of old retorts.

Where the pipes are laid to the grade the slight leaks that occur are determined by closing both ends of the pipe and forcing in air, and the bubbles that arise at once locate the fault. The diver then caulks the joint and makes it tight.

The contract provides that neither pipe shall when completed make more than one gallon of water per hour.

I have no doubt this will be done, and that after a short time the pipes will be absolutely tight.

The only serious difficulty experienced in the work has been that the bed of the river opposite the works of the Newark Gas Light Company is covered with tar deposited there years ago during the early days of the manufacture of coal gas.

This tar filled the trench to a depth of 3 and 4 feet, and it has become so viscous that it has been at times with great difficulty that the diver has been pulled out.

The cost of this work, including the brick inclosures on the East Newark side and the recess in the dock at Newark, the latter being a difficult and tedious part of the work, as nearly all of the material had to be removed by diver, was $13,200 for 1,200 feet of 12-inch pipe.

The Morse Cupola Gas Generating Furnace.

U. S. Letters Patent (No. 410,846) were granted on the 10th inst., to Marcellus A. Morse, of Chicago, for certain improvements in cupola gas generating furnaces.

The invention relates to a cupola gas generating furnace having a fuel chamber at the base in which steam is decomposed, producing water gas, and separate regenerative chambers at the top, one of which is for combining and fixing carbureted water gas, and the other of which is for superheating steam preparatory to its decomposition in the fuel chamber.

The objects of the invention are to provide for better storing and utilizing the heat or heating properties of the gaseous products arising from the fuel at the time it is blasted with air for heating it to incandescence by heating with such products both a gas fixing chamber and a steam superheating chamber; also, to provide for conveniently vaporizing hydrocarbon oil in pipes or channels arranged in a partition wall between the gas fixing and the steam superheating chambers; also, to provide an improved hollow partition wall having a packing of dry sand, whereby any cracks that may occur in the wall will be automatically filled with the sand and leakage of gas or steam from one chamber to the other thereby prevented; also, to provide for passing steam either up or down through the bed of incandescent fuel, and conducting the resulting water gas into the top of the gas fixing chamber near to the place where the hydrocarbon oil or vapor is admitted.

Fig. 1 represents a vertical section, and Fig. 2 a sectional detail showing the preferred arrangement of the oil vaporizing coil in the hollow partition wall.

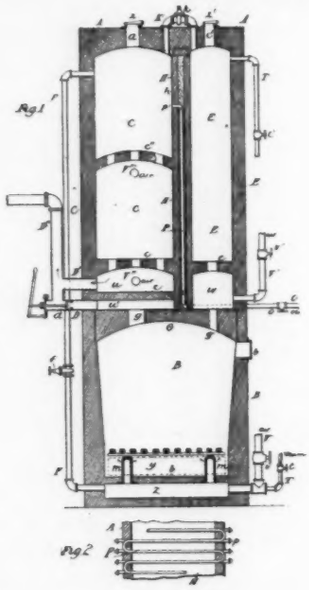
The cupola *A* is built of brick, and in practice is provided with a tight iron jacket in the usual manner, and is divided by a brick arch *G* into fuel decomposing chamber *B* at the base, and the regenerative portion composed of chambers *C* and *D*, containing refractory brickwork or tile at the top.

The fuel chamber is provided with a grate, and below this with chambers *y* and *z*, separated one from the other by horizontal partition *b'*. Chamber *y* serves as the ordinary ashpit, and chamber *z* as the receiving and distributing chamber for air and steam and outlet chamber for water gas.

Perforated distributing channels *m*, opening at the bottom through partition *b'*, are arranged transversely in chamber *y*, and serve to support the grate and distribute air or steam through their lateral perforations under the grate, also to conduct water gas down into chamber *z*, from which it is passed from pipe *F* to the top of fixing chamber *C*.

The fuel charging doors *b* are placed at the top of the chamber *B*.

The upper portion of the cupola is divided by the hollow vertical partition wall *E* into the larger gas fixing chamber *C* and the smaller steam superheating chamber *E*. Chamber *C* is provided near its base with a solid horizontal partition *c*, forming chamber *u'* between it and arch *G*, also with perforated arch *c'*, forming combustion chamber *u*. Another perforated arch *c''* is placed at about the middle of chamber *C*, and the arches *c' c''* serve to support the tile or other refractory brickwork. At the top chamber *C* is provided with outlet *a*, having lid *x*. Chamber *E* is provided near its base with a perforated arch or partition *e*, forming below it combustion chamber *w*, and at the top with escape opening *e'*, having a closed lid *x'*. The large arch *G* is provided with openings *g g'* for conducting gaseous products from fuel chamber *B* into chambers *u'*



and *w*, opening *g* being made the larger, so as to conduct a larger volume of gaseous products up into the larger chamber *C*. Chambers *u* and *u'* are connected by means of pipes *D D'*, and *D''*, and one of these pipes, as *D*, is provided with a valve-box and a valve *d* for controlling the flow of gas. Pipe *D''* in practice leads to a seal box (not here shown) where its end dips into the sealing liquid, as usual. Chambers *C* and *E* are connected at the top by pipe *K*, having valve *k*. An air blast pipe *V*, having valve *v*, connects with chamber *z*, and a steam pipe *T* having valve *t*, also connects with chamber *z*, preferably through the air pipe as shown. Air supply pipe *V*, having valve *v*, connects with combustion chamber *w*, and air supply pipes *V''* and *V'''* connect with chamber *C*, respectively, below arches *c'* and *c''*, as shown. A steam supply pipe *T'*, having valve *t'*, connects with the top of chamber *E*. Partition wall *H* is made hollow, so as to form within it a narrow chamber or space *h*. Within this space is arranged the vaporizing coil *P*, which may be arranged vertically with return bends, as shown in Fig. 1, or horizontally with connections outside of the furnace walls, as shown in Fig. 2. With this latter arrangement of the coil the projecting ends of the tubes which form it are provided with removable screw-plugs, so that a cleaning rod may be pushed through the tubes for removing any deposits that may obstruct them. An oil supply pipe *O*, having valve *o*, connects with the lower part of the vaporizing coil, and a pipe or nozzle *p'* admits vapor from the coil into the carbureting and fixing chamber *C* at any suitable height thereon, but preferably near the top, as shown. A number of nozzles *p'* may connect the coil at different heights with chamber *C*, so as to better mingle the oil vapor with the water gas admitted by pipe *F*. The vaporizing coil having been properly placed in the space *h*, such space is entirely filled with fine dry sand or other dry granular material, so that in case cracks form in the brick wall the sand will run into them and close them up. In case of large cracks, and a high heat being used, the sand would probably be melted, forming a glaze, which would completely fill and cement the cracks, making all tight and preventing leakage of gas or steam through the partition wall. Dry sand alone, however, would sufficiently close the cracks to prevent leakage.

Cupola gas generators have heretofore been constructed with the fuel chamber and a single regenerative chamber in one vertical structure; but it has been found that the large volume of gaseous products given off from the fuel when it was heated to incandescence by blasts of air was much greater than could be advantageously used in heating the carbureting and fixing chamber, since only a moderately high temperature can be economically used in fixing carbureted gas. Therefore the fixing chamber was heated to an injuriously high temperature, resulting in burning the hydrocarbon oil or vapor and forming lampblack, or a large percentage of the gaseous products was allowed to escape and go to waste without being utilized. In either case the operation was wasteful and unnecessarily expensive. Morse, in his construction of cupola, provides an additional chamber *E* for superheating steam, so that when the fixing chamber *C* has been properly heated the gaseous products are shut off therefrom, and are altogether burned in chamber *E*, which may be heated to a very high degree without injuring the steam which is to be passed through it.

The operation is conducted as follows: Lids *x x'* and valve *d* being open, a fire is kindled on the grate, fuel gradually fed in, and the air blast admitted till a deep bed of incandescent fuel is formed. The resulting gaseous products, containing a valuable percentage of carbonic oxide, are conducted through passages *g g'* and the connecting pipes into combustion chambers *u* and *w*, where they are burned by the admission of air through the pipes *V'' V'''*. A second supply of air may be admitted by the pipe *V''''*, if necessary to complete the combustion in chamber *C*. Chamber *C* will be the most highly heated at the bottom, and gradually to a decreasing temperature towards the top. When the fixing chamber *C* is heated to the proper temperature valve *d* and lid *x* are closed, and all of the gaseous products are then burned in steam superheating chamber *E* till it is very highly heated. The fuel having been heated to the proper state of incandescence, and the chambers *C* and *E* properly heated, as above described, the lid *x'* is closed and all the air blast shut off. Valve *f* in pipe *F* is now opened, and steam is admitted by pipe *T'* into the top of superheating chamber *E*, in passing through which it is highly superheated. It is then passed down into and through the incandescent fuel in chamber *B*, where it is decomposed with very little loss of heat to the fuel. The resulting water gas passes by pipe *F* into the upper part of carbureting and fixing chamber C, and at the same time hydrocarbon oil is admitted into the vaporizer *P*, where it is vaporized, and the resulting vapor passes by nozzle *p'* into chamber *C*. The hydrocarbon vapors immediately diffuse through the water gas and combine with the hydrogen thereof, and the resulting illuminating gas is fixed by passage down through chamber *C*, and it finally escapes by pipes *D'* and *D''* to the seal box and washer. In this way a long run and a very large volume of gas may be generated before the temperature of the cupola is too much lowered for successful operation.

In the operation of the apparatus and after steam has been passed down to the fuel the direction thereof may be reversed. In this case valve *f* is closed and valve *k* opened. The valve in steam pipe *T'* is closed and the valve in steam pipe *T* opened. Steam is now admitted to chamber *z*, and is distributed by perforated channels *m* into the base of the bed of the fuel. It is decomposed by passing up through the fuel, and the resulting water gas passes up through chamber *E* and through pipe *K* into the top of chamber *C*, where it is carbureted, combined and fixed, as before explained.

It has been found in practice that a larger yield of gas and better results are secured by passing the steam at different periods both up and down through the bed of incandescent fuel. When water gas is passed down through the grate, it escapes through the perforated channels *m* into chamber *z*, from which it is conducted by pipe *F*, as before described.

Having thus described his invention, Morse makes the following claims:

1. In a cupola gas generator, the combination of the fuel and decomposing chamber, the gas fixing chamber and the steam superheating chamber separated one from the other by a vertical partition and connecting at the bottom with such fuel chamber, a steam supply pipe connecting with the top of the superheating chamber, supply pipes for gas and oil vapor, and a gas outlet pipe connecting with the fixing chamber.

2. In combination with the fuel and decomposing chamber placed in the base of the cupola, the superheating and fixing chambers placed above, the arch at the top of the fuel chamber, having openings for gaseous products leading into such superheating and fixing chambers, a valve pipe connecting the chambers at the top, and an escaping pipe leading from the base of the fixing chamber.

3. In a cupola gas generator, the combination, with the fuel and decomposing chamber, of the regenerative portion of the cupola placed above and divided by a vertical partition into a gas fixing chamber and a gas superheating chamber, each connecting at the bottom with the fuel chamber and having at the top an escape opening for products of

combustion, and a closing lid and pipes for supplying air, steam, and oil or vapor to the chambers, and a gas eduction pipe, whereby the heat of the gaseous products arising from the bed of the fuel while it is being heated may be better stored and utilized for fixing gas and superheating steam.

4. The hollow partition wall for separating the fixing chamber from the superheating chamber having its space filled with dry sand or equivalent material for closing cracks which may occur in the wall.

5. The combination, with the fuel and decomposing chamber placed in the base of the cupola, of the regenerative portion of the cupola placed above and divided by a hollow vertical partition wall into a gas fixing chamber and a steam superheating chamber and an oil vaporizing pipe or coil arranged in the space of such wall, and a vapor pipe leading therefrom into the fixing chamber.

6. In combination with the fuel chamber, the fixing chamber and superheating chamber arranged and connecting, as described, a distributing-chamber z, arranged below the ash-pit, having air and steam supply pipes, a pipe for water gas leading from chamber z to the top of the fixing chamber, a valved pipe connecting the tops of the fixing and superheating chambers, and a steam supply pipe connecting with the top of the superheating chamber.

8. In combination with the fuel chamber of the cupola, the supply and distributing chamber z, arranged below the ash-pit, perforated channels m, communicating with such chamber and extending into the ash-pit, the steam and air supply pipes connecting with chamber z, and an escape pipe for water gas leading from such chamber to the fixing chamber of the cupola.

Sources of Ammonia.

A feature of the annual address of Ludwig Mond, presented by him at the eighth annual meeting of the Society of Chemical Industry (England), was his reference to the subject of ammonia. Respecting the value of science in connection with the industrial pursuits, he said there would soon be a science of invention—that is, of developing scientific methods for solving industrial problems; and as exemplifying to a certain extent the application of methodical research to such a purpose, he proposed to give an account of the work that had occupied him for many years, in relation to the procuring of new and abundant supplies of ammonia, as a source of nitrogen for manurial purposes. As illustrating the immense importance of this subject, he mentioned that during the past year no less than 650,000 tons of nitrate of soda had been exported to Europe from South America, the value of which was not less than 6½ millions sterling.

It was well known that ammonia was composed of two elements, nitrogen and hydrogen, both of which existed in great abundance. As sources of nitrogen, there was matter of vegetable origin, matter of animal origin, and the atmosphere, which contained 79 per cent. of uncombined nitrogen. Innumerable attempts had been made to produce ammonia by the direct combination of its elements, as well as by indirect means. In olden times it was obtained by the distillation of camel dung, urine, bones, or horn. The introduction of coal gas afforded a considerable supply of ammonia as a bye-product; and until recently all practical efforts to increase the ammonia supply had been directed towards collecting and utilizing in the best possible manner the ammonia so obtained. The immense extension of the coal gas industry all over the world had resulted in a large production of sulphate of ammonia, amounting in Europe alone to 140,000 tons per annum; and this had been further augmented by ammonia obtained by the distillation of shale, by the introduction of closed ovens for the manufacture of coke, combined with apparatus for abstracting the ammonia from the resulting gases, and the application of similar apparatus to the gases from blast furnaces. But all these new sources had only made up a total supply of 180,000 tons per annum, of which 120,000 tons were produced in the United Kingdom, and the 650,000 tons of nitrate of soda, equivalent to 500,000 tons of ammonia, were imported in addition to make up the requirements.

Amongst processes for obtaining ammonia from other sources, the distillation of turf, and the utilization of the nitrogen of the atmosphere, had received much attention, but neither had been successful on a manufacturing scale. As far back as 1861 he undertook experiments having for their object the utilization of waste leather for the production of ammonia. This material contained no less than 12 to 15 per cent. of nitrogen; and distillation in iron retorts yielded about half the nitrogen in the form of ammonia, the remainder being left in the retort. Distillation with a moderate quantity of slaked lime increased the yield, but only to the trifling extent of 1 to 1½ per cent. The residual carbon, ground and mixed with lime and then distilled, gave rather better results, but still far below the quantity theoretically obtainable; and so he concluded that the more rational plan for the utilization of the nitrogen in the leather, was to grind it to powder and mix it directly with other manures. A few years later, he became connected with a large animal charcoal works, in which sulphate of ammonia was obtained as a bye-product; but here again he was met by the fact that the yield of ammonia was only about half the quantity indicated by the proportion of nitrogen present in the charcoal. In 1879 he determined to submit the various processes that had been proposed for obtaining ammonia from the nitrogen of the air, to a searching investigation. In these it was sought (1) to combine nascent hydrogen with nitrogen at high temperature or by electricity, with or without the presence of acid gases; or (2) to form nitrides in the first place, from which ammonia was obtained by the action of hydrogen or steam; or (3) to form cyanides, and obtain ammonia from them by the action of steam. Beginning with the processes in which a mixture of steam and nitrogen, or of steam and air, is made to act upon coke at a high temperature, sometimes in the presence of alkalies, or alkaline earths, sometimes in the presence of hydrochloric acid, a very large number of experiments were conducted at carefully determined temperatures, ranging from 500° to 1,200° C. In every case it was found that the yield of ammonia was the same, whether nitrogen was introduced into the apparatus with the steam, or whether steam alone was used; proving conclusively that the ammonia obtained was not derived from the nitrogen of the air, but from that present in the coke. The quantity of ammonia so obtained very nearly corresponded with the total nitrogen in the coke. A process in which a mixture of carbonic oxide, steam, and nitrogen, is made to pass over lime at a moderate red heat, was also carefully tried, and found to be utterly useless so far as the production of ammonia is concerned.

With regard to the formation and subsequent decomposition of nitrides, the compounds of boron and titanium with nitrogen had received most attention from inventors; but there were practical objections to the use of boron. In a process patented by M. Tessie du Motay, it was proposed to bring a mixture of nitrogen and hydrogen into contact with titanium nitride, and thus to form ammonia by a continuous process, the titanium acting as a carrier of nitrogen. This metal formed several combinations with nitrogen; and the higher of these, on being acted upon by a current of hydrogen at an elevated temperature, produced ammonia and a lower nitride of titanium. But this lower nitride would not absorb nitrogen under any of the conditions tried; and therefore, although he was able to obtain the result just mentioned, he had failed to get the nitrogen of the air into action.

On trying cyanides, however, he at once found that the nitrogen of the air could be led into combination. The cyanide of barium was found to be much more readily formed than any other; and full attention was therefore directed to the process of obtaining ammonia by the medium of this compound, invented by MM. Margueritte and Sourdeval. This comprised the heating of a mixture of carbonate of barium and carbon in the presence of nitrogen, and the subsequent treatment of the cyanide of barium thus produced with steam, which resulted in the formation of ammonia together with the reproduction of carbonate of barium. It was found that the carbonate of barium fused at high temperatures, and when in this state attacked fire-clay with energy; but when mixed with carbon and a small quantity of pitch, the carbonate of barium formed balls that would not fuse. These could be used in a continuous apparatus, being charged in at the top, and withdrawn from the bottom when required. The formation of cyanide required a temperature of 1,200° C., and proceeded most regularly at 1,400° C.; and no difficulty was found in obtaining as much as 40 per cent. of the barium present in the form of cyanide. It was absolutely necessary to cool the cyanide down to 300° C. or less before exposing it to the air, as otherwise it readily decomposed with formation of carbonate of barium. The operation for producing ammonia from the cyanide by treatment with steam, offered no difficulty whatever. The regenerated carbonate of barium acted even better than that used in the first place; so if care was taken to avoid the introduction of impurity by the pitch used to remake the balls after each operation, there was no reason why it should not be used over and over again for a long time.

The apparatus used for the manufacture of the cyanide, consisted of vertical fire-clay retorts with thin walls, extending right through the hearth as well as the arch of the furnace, having a cast iron mouthpiece on the top, and a continuation of the same material below. The material was fed in at the top, and extracted in small quantities at a time from the continuation at the bottom, which served as a cooling chamber. The cooling was further assisted by the introduction of cold nitrogen (gases from the carbonating towers of the ammonia-soda process) at this point.

A very large quantity of heat was absorbed in the process, and therefore it was necessary to use retorts having very thin walls. At the time he had difficulty in meeting with fire-clay of suitable quality, and therefore abandoned the experiments; but he had since been experimenting, for a different purpose, with an excellent quality of fire-clay used at zinc works, which he thought would be very suitable for the construction of retorts for this process. He believed that the process would prove remunerative for the production of cyanides, which, if produced more cheaply, would in the future play an important role in connection with several chemical and metallurgical operations. It certainly offered a solution of the problem of obtaining ammonia from the nitrogen of the atmosphere, though he could not say whether this could be done with satisfactory commercial results. The fact that he had found means to produce ammonia at small cost from coal, rendered him the more doubtful on that point.

Amongst other processes for obtaining ammonia from the nitrogen of the air, he had investigated that patented by Messrs. Rickman and Thompson, which was based upon the supposition that when air and steam were passed through a deep coal fire, the nitrogen so passed through was to a certain extent converted into ammonia. This process yielded a good supply of ammonia; but when the same quantity of coal was burned by means of steam alone in a tube heated from the outside, the yield was twice as great, proving that the source of the ammonia was the nitrogen present in the coal. But the results were so promising as to lead to the following up of the process on a semi-manufacturing scale. Although the treatment of the coal in closed vessels yielded the best results, he concluded that it could never be an economical process, as it necessitated the use of costly and complicated apparatus. On the other hand, the plant for burning coal in gas producers by a mixture of air and steam would be simple and inexpensive, and the producer gas yielded would meet to a large extent the cost of the coal used. It thus seemed that this was the preferable plan, though only one-half the theoretical yield of ammonia was obtained. He had since constructed gas producers and absorbing apparatus of various designs, and carried on experiments extending over many years, with the object of determining the most favorable conditions for the economical working of the process with respect to the cost of manufacture, as well as the first cost and simplicity of the plant. The best yield of ammonia was obtained when the apparatus was worked at the lowest temperature compatible with a good combustion of the coal, and when the quantity of steam introduced was equivalent to twice the weight of the fuel consumed. Numerous kinds of common slack and burgy from the Lancashire and the Midland districts were tried, and did not present much difference in regard to the proportion of nitrogen, which varied between 1.2 and 1.6 per cent., or in the yield of ammonia if worked under similar conditions. The average yield was 0.8 per cent. of ammonia, equivalent to nearly 70 lbs. of sulphate per ton of coal. A great depth of fuel was necessary; but the low temperature prevented trouble from clinker, or the liability to cake together. The large quantity of steam which was necessary to the securing of a good yield of ammonia threatened to become a considerable item of expense. As only one-third of it was actually decomposed, leaving two-thirds mixed with the producer gases, attention was continually directed to the recovery of this steam, and its return to the producers; and also to the utilization of the heat of the gases, which leave the generator at 450° to 500°, for raising steam. The difficulties in the way of attaining this end, together with the recovery of the ammonia, were very great. The yield of gas per ton of coal was 160,000 cubic feet, besides the excess of steam, which added another 80,000 cubic feet; and the large amount of latent heat in the steam increased the difficulty of the problem. After trying a number of different kinds of apparatus, the following plan was found satisfactory: The gas from the producers was first led into a large rectangular chamber partly filled with water, which was thrown up in a fine spray by revolving beaters, so as to fill the whole area of the chamber. From this it passed to a scrubber filled with perforated bricks, where it was treated with weak sulphuric acid; and next to a second scrubber packed with perforated wood blocks, and supplied with cold water. In the rectangular chamber, all dust and soot, together with the tar, are removed from the gas, and also the fixed ammonia, and the temperature of the gas is reduced to 100° C. In the first scrubber nearly the whole of the rest of the ammonia is removed; and in the second, the gas is cooled and the excess of steam is condensed. The tar, etc., from the rectangular chamber passes off through proper overflows; and a certain portion of the water, which becomes heated and charged with ammonia salts, is regularly drawn off and treated with lime for the recovery of the ammonia. The liquid used in the first scrubber is really a solution containing from 36 to 38 per cent. of sulphate of ammonia, to which a small quantity of sulphuric acid has been added, care being taken that the liquor at the outlet shall not contain more than 2.5 per cent. of free acid. If this proportion is exceeded, the tarry matters are acted upon, and a dark-colored solution is produced. At the outlet of the scrubber the liquid passes through a separator, to remove tar, etc.; a certain portion is retained for evaporation, and the remainder, after receiving a fresh charge of acid, is used over again in the scrubber. The mother liquor from the sulphate evaporating pans, which retains the free acid, is also used again in the scrubber. The hot water from the second scrubber is first passed through a tar separator. It is then supplied to a scrubber through which the air supply for the producer is forced by means of a Roots blower. The water is thus cooled sufficiently to be used again; and at the same time the air is heated to about 76° C., and saturated with water vapor at that temperature. Thus the same quantity of water is used over and over again for condensing the water vapor from the gas in one scrubber, and giving it up to the air in another. In this way fully two-thirds of the steam originally introduced is recovered and returned to the producer, and the air treated as above mentioned requires only an additional quantity of steam equal to one third of the total quantity required. This additional steam is furnished by the exhaust of the engines driving the blowers and pumps used for working the plant.

The shape of producer preferred is rectangular, 6 feet wide by 12 feet long, so that a number can be set in a row. The air is introduced and the ashes removed at the front and back, which taper toward the middle and are closed at the bottom by a water lute of sufficient depth, the ashes being taken out from underneath the water. The air is forced in just above the water level, through a pipe connected with the blower, at a pressure equal to about 4 inches of water. The gas outlet pipe passes out at the center of the top, and extends down a sufficient depth to meet the incandescent fuel. The charging hoppers are situated one on each side of this pipe. The fresh fuel being kept well above the level of the mouth of the pipe, no gas can pass off without first going through a certain thickness of incandescent fuel, thus decomposing tarry products or coal dust. This object is further assisted by hanging arches fixed on each side of the pipe. The fuel used contains about 33½ per cent. of volatile matter, 11½ per cent. of ash, and 55 per cent. of non-volatile carbon. The cinders from the producer contain about 33 per cent. of carbon: but about one-half are riddled or picked out and returned to the producer, so that the amount of carbon lost in the cinders is not more than 3 or 4 per cent. of the weight of fuel used. The gas obtained consists, when dried, of 15 per cent. of carbonic acid, 10 per cent. of carbonic oxide, 23 per cent. of hydrogen, 3 per cent. of hydrocarbons, and 40 per cent of nitrogen. Its calorific value is about 73 per cent. of that of the fuel used; but it can be completely burned with almost the theoretical quantity of air, and therefore will evaporate 85 per cent. of the quantity of water that could be evaporated by burning the fuel direct in ordinary fireplaces. After allowing 0.6 ton of steam for the producers, and 0.1 ton for the evaporation of the sulphate, the available amount of steam raised by the gas from one ton of coal is 5.1 tons, or about 75 per cent. of the steam that could be obtained from the same fuel by hand firing. In addition to the gas, about 3 per cent. of tar is obtained from the coal. It is very thick, and of little commercial value, so has not been much utilized except as fuel. It evaporates nearly twice as much water as an equivalent weight of coal; and this added to the value of the gas above given, makes up a total evaporative efficiency equivalent to 80 per cent. of the fuel used in the producers, leaving a loss involved in the gasifying of the fuel for the recovery of the ammonia, of about 20 per cent. of the fuel used. The consumption per ton of sulphate obtained is therefore 6.25 tons, which at present prices at Northwich represents a value of 35s. Adding the extra cost of labor over and above the cost of burning fuel in ordinary fireplaces, together with the cost of sulphuric acid, bags, etc., we arrive at a total of £4 10s. to £5 per ton of sulphate. At present prices this leaves, after liberal allowance for wear and tear, etc., a good margin of profit; but with a rise in the price of fuel this margin would rapidly decrease. The working expenses and cost of plant would be more costly on a small scale; so at present the great advantages, over and above the profit arising from the manufacture of sulphate, viz.:—the absolute impossibility of producing smoke, and the great regularity of the heating resulting from the use of gas, were only available for large consumers of cheap fuel.

He had endeavored to produce hydrochloric acid in the generators, so as to fix the ammonia in the form of chloride. It was known that the chloride was not so readily dissociated by heat as free ammonia, and therefore he hoped to increase the yield by this means, and at the same time to produce the acid necessary to combine with the ammonia at small cost. The fuel used was moistened with concentrated brine, or with waste liquors from the ammonia-soda process. Balls made by

mixing very concentrated solution of chloride of calcium with clay were also tried. Hydrochloric acid was produced, but in irregular quantity. So long as it was not in excess, the free ammonia could be absorbed in the usual way; but the great difficulty was that they could not guard against an excess of hydrochloric acid, which would act upon the plant. The yield of ammonia was not in any case increased by the presence of hydrochloric acid.

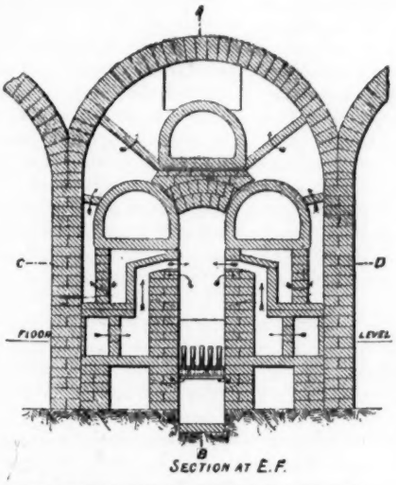
The fuel consumption of this country, he said, was no less than 150 million tons per annum. So if only a tenth of this quantity was treated for sulphate of ammonia, England alone could supply the whole of the nitrogenous compounds at present consumed by the Old World. As the process was specially profitable to large consumers of fuel, situated in districts where fuel was cheap, it was particularly suitable for adoption in this country.

A Retort-Setting for Small Gas Works.

[A paper read by Mr. Adam MacPherson, of Kirkcaldy, before the North British Association of Gas Managers.]

The subject I propose bringing before you to-day is one which in recent years has been prominently brought before our meetings by managers of small gas works, who, since the introduction of regenerative ovens for larger works, have shown a laudable desire to so improve the present methods adopted in such, as to participate at least to some extent in the benefits which have been found to result from the improved regenerative settings; while, at the same time, having an eye to the sometimes scanty means at their disposal, they have been anxious to secure this by as simple a means as possible, so as not to burden themselves with a heavy expenditure. I think it is needless for me to say this desire on their part has our sympathy and support; and having been during last summer called upon to renew and remodel the retort-bench of the Dysart Gas Works, I resolved to, if possible, elaborate a plan by which some of the savings resulting from regular regenerative settings might be secured without incurring any excessive expenditure. Being aware of all that has been done in the way of trying to improve the ordinary setting by Mr. Watson, of Stirling, and Mr. Yuill, of Alloa, and having given what they had done careful study, I resolved to go somewhat on some of their lines. I do not therefore claim entire originality for the setting, as I shall endeavor by the aid of the drawings to explain it to you. One thing, however, I do claim as original, is the passing of the primary air of combustion over the main flue, and thereby recovering some of what would otherwise be heat entirely lost. This, in the present instance, is no doubt accomplished in a very simple and perhaps crude way; but from the results obtained, I am satisfied it is a principle which would repay further careful study and elaboration, which might be accomplished at a very moderate cost.

You will observe the form of the furnace is quite different from the ordinary setting, in that the furnace bars are placed at a very considerable angle, whereby a very much greater depth of fuel is obtained; and



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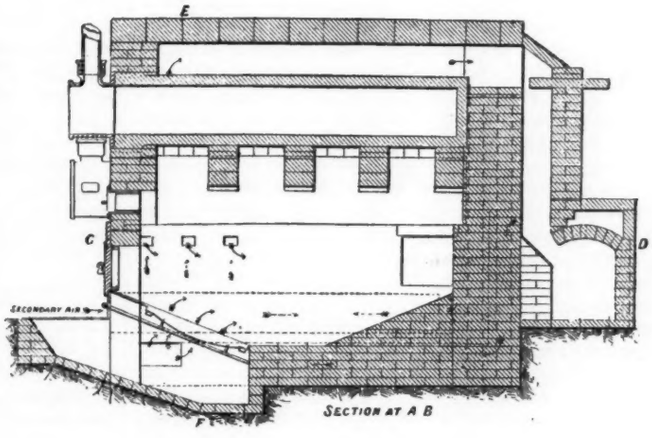

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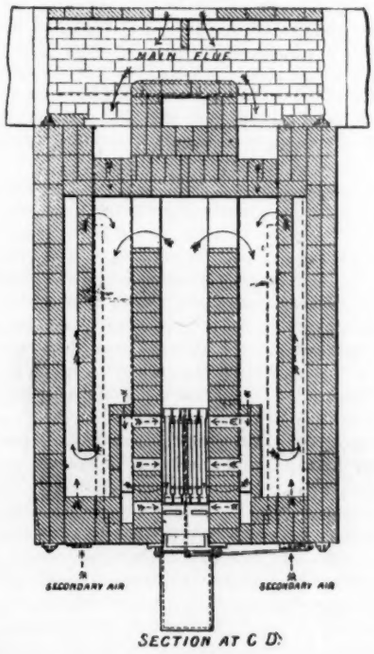

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it is of such capacity as to hold sufficient fuel to last for three hours, which of itself is a considerable saving of labor to the stoker, as well as preserving the heat of the oven and protecting the retorts from the injurious effects of the rush of cold air through the setting every time the furnace door is opened for firing purposes. You will also see that although for economy's sake the old furnace doors and frames have been used, these are not used for the purpose of supplying fuel to the furnace, but are made air tight, and only used once in twelve hours, to permit of the small quantity of ash which it has been found expedient to remove at such intervals, being raked out, which can be accomplished in the space of a few minutes, the operation being very easily done, and there is no clinker. A clinker bar is never used; and I may say, except in the very busiest time in the winter months, it is found sufficient to clean the furnace thoroughly out every 24 hours only. The fuel for the supply of the furnace is passed in through the opening between the two lower retorts, into which, with the aid of a small hopper, the hot coke from the top retort is passed; and, as I said before, the furnace being of sufficient capacity to hold fuel to last 3 hours, this is done every time the retort is drawn. Should the charge drawn from this retort not be enough, a few shovelfuls from one of the others can be thrown in through the hopper to supplement it.

I would now wish to draw your attention to the method adopted to supply the necessary air for combustion to the furnace. It is first admitted into the space formed over the main flue, as is shown in the drawing, and is drawn along this space. In its passage it will doubtless pick up some of the heat from the arch forming the top of the main flue. It then passes down, and is led forward under the setting, and introduced to the space below the furnace by the openings shown. A steampipe is also introduced (of the form shown) immediately below the bars, with the effect of increasing the draught, preserving the bars, and keeping the furnace free from clinker. I will now point out how I introduce and heat what may be called a secondary air supply. The air is admitted below the flues by which the heated products of combustion pass to heat the bottoms of the lower retorts into flues specially constructed for it;

and after passing backwards the whole length of the setting, is again brought forward and carried up the sides of the furnace, and passed into it just over the fuel, so as to be immediately brought into contact with gases being evolved therefrom. These gases then pass on along the setting, through the opening at the back, and travel forward along the bottoms of the lower retorts; then back along the sides; again forward; again back; and are conducted then into the main flue—all as will be clearly understood by a reference to the drawings and the arrows thereon. I would also desire to direct your attention to the method of covering in the flues for the conducting of what might be termed the secondary air supply. I have, as you will see by the drawing, separated the flues over these not by a single cover but by a double cover, my reason for this being that, as is well known, covers when heated or cooled down, unless this is very carefully done, are apt to crack or fracture; and as I supposed these might be subjected to such influences as would bring about such a result, I thought that by having the double row of covers to better isolate the two set of flues, and prevent any communication being formed between them, which, of course, would be injurious, thinking it unlikely, if a fracture did take place, that both covers would fracture at the identically same place. At least I would say the chances are very much against such a thing taking place.

Having endeavored to explain to you as clearly as I can the construction of the setting, I will now proceed to give you a few of the advantages which I claim for it, as having been brought out in actual working during the past winter. During the previous year with the old setting, it was found it required 4 hours to properly carbonize a charge of 2¼ cwts. per retort. This is accomplished by the new setting in 3 hours; and better done, the charge being thoroughly exhausted in that time, which was not always the case in the old setting even with 4-hour charges. Here then has the productiveness of the setting been increased by 25 per cent., an improvement which by itself would fully justify its adoption. But then added to this we have an increased yield of gas per ton of coal of 1,400 cubic feet, and a saving of fuel, even in obtaining such greatly improved results, amounting to one-third of what was previously required, to say nothing of the great ease to the stoker in saving him entirely from what certainly was before his most disagreeable and laborious work, in cleaning and clinkering the furnace, as well as the repeated filling thereof by the shovel. Besides the great conservation of heat experienced, where it is necessary (as it is at certain seasons of the year in numerous small gas works) to damp down at night, to find in the morning that instead of having to draw the damper and proceed to clean and clinker the furnace, and then keep firing on for an hour or two before you can get the heat of your retorts into such a suitable condition as to justify you in charging them, you have only to draw your damper and proceed to put the charges into your retorts, after merely drawing a little ash out of the furnace; the heat of your retorts being very little if any worse than when you left them the previous evening, and certainly quite good enough to carbonize effectually the charge put into them. I think I may safely say that not only would its adoption be fully justified, but would be amply rewarded in the way most pleasing to gas managers in a very considerable increase of profits and a lessening of what we are all prepared to admit is somewhat laborious work for our men.

But now, I may be told this is not a regenerative setting. No, nor do I claim for it such a designation; but what I do claim is this, that whatever kind of a setting it may be designated, if it accomplishes the end for which it was intended, and which was, as I stated before, to enable managers of small works to achieve what they have for some years back been aiming at—to devise a setting which will be an improvement to the old method, and so enable them to participate in the benefits found to accrue from the higher and more equal temperature obtained by the adoption of truly regenerative settings—then my end has been accomplished. And although, if possible, we prefer to work on truely scientific principles, I do not think any of us would be justified in rejecting this or any other setting from which such advantages can be obtained, merely because the principles of construction do not accord with scientific theories. What is wanted is something to do the work, and that at as small an outlay, consistent with efficiency, as possible.

Discussion.

The President said that the subject brought forward by Mr. MacPherson was one which concerned managers of small works very much; and he hoped they would not be slow to express their views thereon. If any gentleman has been trying something of the kind of his own, or a modification of it, they would be glad to have his opinion.

Mr. W. Key (Tradeston, Glasgow) said he had some retort settings on an angle very similar to Mr. MacPherson's. In the winter time, when they took on fresh hands, who were not accustomed to placing the fuel sufficiently well back, he tried these settings, in order that the men might put the coal on a level slope. In the Tradeston works there were three of these furnaces which had been built on this slope, for at least 10 years; and he had another retort (not at Tradeston) with the same kind of door, where they could damp off in a similar way. It was a very good advantage; and certainly Mr. MacPherson had done well to introduce both these things. As to the heating of the air by the main flue before passing it through the fire-bars, a Mr. McAra, a lime burner of Glasgow, took out a patent at one time for a lime kiln, and on consulting him, he advised that the air for the kiln, which was longitudinal, should be heated on the same principle as was shown on MacPherson's diagrams. The setting was as simple as it could possibly be; and he was not at all surprised that there should be considerable benefit by heating the air, as Mr. MacPherson had done, before admitting it to the furnace. Mr. MacPherson deserved credit for designing such a setting.

Mr. J. Hall (St. Andrews) was afraid they would not have much discussion on the paper probably, because the furnace was new; and they must accept Mr. MacPherson's explanations as to the benefit which accrued from using it. Looking at the drawings, he thought it was a very sensible setting. To him, one of its main recommendations was that it was simple; because if small gas works were to be improved in these matters, unless the improvements were simple, they would not be effected. During the past two winters he had had a setting similar to the one shown, though with four retorts. He introduced two small flues at the bottom, below the flues which heated the bottom of the retorts. It went backward, came forward, and then backward again, until it came to just about the farther end of the furnace bars. The benefit resulting from it was very marked indeed, not only in heating the retorts, but in simplifying the clearing of the bars, and his stokers, one and all, declared that it was a great advantage. It commended itself highly, he thought, to managers of works who might have difficulty in excavating deeply. He thought Mr. MacPherson deserved much credit, not only for his admirable paper, but for the drawings he had placed before them.

Mr. T. D. Hall (Montrose) agreed that they were certainly indebted to Mr. MacPherson for the trouble he had taken in preparing the paper, and for his excellent drawings showing the air flues. He had really hit upon something new. He himself did not know much about regenerative furnaces; but in the drawings he had previously seen, he did not think that there was any provision for heating the primary air supply. He thought Mr. MacPherson could really claim something new in that. He himself had put in flues under the furnace flues for heating the secondary, but not the primary air supply. With regard to the way in which Mr. MacPherson put his secondary air supply into the furnace, he would suggest—and perhaps Mr. MacPherson would give his opinion on the subject—that the secondary air should be admitted to the furnace a little farther back; he would say immediately behind the furnace bars. This was where he admitted his secondary air; and he considered it to be the best place.

Mr. J. Hall said he thought there could be no doubt that the air passing through the flues before it reached the furnace was well heated.

Mr. A. Bell, Jr. (Peebles), in the course of some remarks upon the paper, said he found no difficulty in melting a set of retorts in two months, after which they altered the admission of the secondary air so as to allow the heat of the primary combustion to expend itself in doing useful work. Then, by bringing the products of combustion and the secondary air into contact, the consequence was that they obtained a very regular heat all over the furnace. Their experience bore out exactly what Mr. Foulis stated in his address to The Gas Institute two years ago—that it was necessary to cause the combustion to take place gradually, and not in one place. Mr. MacPherson would, perhaps, in his reply, say whether he had found any inconvenience in consequence of over heating at one place.

The President remarked that the subject before them was a very interesting one, and they were highly pleased to have a discussion upon it. There was no doubt that any modification that came short of the full system of regeneration must be acceptable to small gas companies. This, he thought, was such a system as must be interesting to all who managed small gas works; and his "get-up" was exceedingly creditable. There were fears that the passage of cold air over the top of the main flue might fracture the retorts, and the whole of the air would be drawn right through into the main flue, instead of performing its purpose of primary combustion. Otherwise the arrangement was, to his mind, very good. It was somewhat similar to what had been done by their friend Mr. Bell, at Peebles. In his own system he found that exactly the same result took place—in a short time everything in the

neighborhood was run down. The plan now was to introduce the gases and the air together, so that they mixed in a complete manner; and by this means they obtained a uniform heat throughout the entire oven, which was a very important point. They were indebted to Mr. MacPherson for introducing this subject; and would be glad to hear what he had to say in reply.

Mr. MacPherson said that if Mr. Key had attended to what he had said, he would have seen that he did not claim originality for the slope of the bar. He was not aware of the application of the oven to lime kilns; but in the paper he was only dealing with gas ovens. With regard to what Mr. Bell had stated about heating, he might say his experience had not been the same. He found that the secondary air was introduced at the proper place. They could work with a very light draught; consequently there was no cutting action, and no extra heating took place round the nostrils, which might be expected, where the two gases joined, but nothing which could be called a destructive action. The slope of the furnace bar he put specially to get the depth of fuel, so that they might do without charging the furnace except when drawing the retorts.

Mr. Key—What is the vacuum in the combustion chamber?

Mr. MacPherson—I do not think we ever took the vacuum except by looking through the sight-hole, when we saw that the combustion took place very leisurely and lazily.

Mr. J. Hall—Do the lower retorts burn?

Mr. MacPherson—No; we do not find that.

Mr. Hall—Then the bottom of the top retort is open to the heat?

Mr. MacPherson said it was right along. He did not the least doubt that by the carrying the heat up first and then backwards, they might have the top retort heated better than the lower one. Replying to Mr. J. McNair (Wishaw), he said that to avoid reducing the heat it might be judicious to take a retort from each oven in drawing. To another gentleman who asked the percentage of coke required for the furnace he answered that the yield of the top retort, with very little more, generally kept it going.

Secondary Batteries at the Paris Exposition.

The Paris correspondent of the *Western Electrician*, in a batch of notes on this subject, says:

Every one knows how much easier it is to criticize than to perform or reform, but there does seem to be some ground for complaint in respect to the facilities for finding any particular object at the exposition. This is illustrated in the matter of accumulators. Thus there are 23 exhibits of accumulators, and they are scattered about among the exhibits of three nations in the gallery of the machinery hall, on the floor of the machinery hall, and in one of the industrial buildings. At least one day of hard work will be required to find and give a cursory glance at these exhibits. Most of them are in the French section on the floor.

The father of the accumulator, Gaston Plante, is dead, and a bit of dusty mourning twisted over his exhibit, is one of the touching things of the exposition. He seems to have been universally admired by all who knew him, and many are the words of regret which one hears from the passers-by, as they speak of him. In his exhibit are shown several objects of historic interest. Plates originally made and used by him as early as 1860 are shown. Also his first battery in the form of a cylinder about 10 inches by 5. There is also shown an apparatus made by him in 1863, consisting of 20 small jars or tubes, 1 x 4 inches, containing each two little plates. The positive plates are connected with a longitudinal strip on one side of a rotating bar above, and all the negatives, with a similar strip on the opposite side of the bar by means of spring metal connectors. Transversely through this rod are pins which engage each a positive and a negative connector when the rod is rotated through 90°. Of course this form is now well known, but the original work of the inventor is none the less interesting. Plante's celebrated work on the subject of accumulators is also exhibited.

The Siemens accumulator is composed of lead frames or plates in combination with a kind of metallic fiber which contains the active material. This fiber is prepared as a sort of moss, and is then forced under considerable pressure into the apertures in the frame or plate. When the process is completed the side of the plate is in appearance covered with irregular striations. The internal resistance of such a plate would seem to be at least equal to the average.

In the Garassino accumulator the plates are not perforated, but cast large square indentations, having irregular or ridged bottoms to retain the active material. The general appearance of the battery when completed is similar to others. The chief feature claimed by the inventor is that he prepares the spongy lead material before the same is applied to the plate, and that when it is so prepared and applied, the time required for "forming" is much less and the delivery far more effective. The inventor is an Italian from Turin.

The Julien accumulator is exhibited by L'Electrique, a Belgian company, and their display is perhaps the finest exhibit devoted to accumulators. They have a large number of elements, many of them in use being charged by small dynamos running from the main shaft.

They also show a very large number of plates in all conditions, formed and unformed; also with and without the active material. Of course much stress is laid on the allegation that the frame or support is non-oxidizable. It is claimed that the accumulator renders 80 per cent. of the charge. One interesting object in this exhibit is a small Faure plate, said to have been used three months. The fragments are secured against a velvet background in the glass case, and the spectacle is not calculated to afford any special satisfaction to the rivals of the Julien Company.

The Faure-Sellon-Volckmar accumulators are exhibited by Philippart Freres. This type is used on the electric tramway, which runs from Porte Maillot to the Place de l'Etoile. Two classes of plates are shown. In one class the plates are single and are placed in the fluid so that each alternate one is positive. All the positives are then connected along one side of the jar, and all the negatives along the other, the connections being soldered. This is the old style of mounting. The new and much-vaunted form of plate is one wherein two plates—one positive, the other negative—are permanently connected by a bridge. The plate so formed is called a "plaque jumelle." A series of positive single plates, each with a projecting arm, is placed in the first jar. Alternating with them is placed a series of double negative plates, the ends of such plates naturally coming into the next jar. The first jar contains a series of single negative plates. The connection is made at each end. The plates are insulated by glass yokes. They may be connected when desired at the bridges by cross-bars. A large set of the batteries is displayed. They are charged by an Edison dynamo, and used to energize a beautiful group of incandescent lamps and some small motors. A curiosity in this exhibit is a series of double plates, riveted together, each with undercut apertures which coincide so as when the two are riveted together to make a series of internally enlarged apertures to contain the active material. These plates are marked, "tried and abandoned in 1883." This, however, is the exact form of plate patented, and now somewhat extensively used and exhibited under the name of the Yadot accumulator, the invention of Paul Yadot, of Paris. The pieces of active material are about twice as long as they are wide. When the plates are formed they are quite likely to be loose and capable of a little motion in their respective apertures.

The Peyrusson accumlator consists of a central conical-shaped piece with a bottom and vertical ribs, between which the active material is deposited. The whole is then surrounded by a fibrous cloth, and about it is placed in the form of corrugated metal the other portion of the element. This accumulator is made sometimes in part of tin and sometimes in part of admium.

Le Jeune's plate has two layers of narrowly separated horizontal strips. The active material lies between these strips and also between two rows of strips. The two sides of this plate are connected together by yokes The plates are then interlaced, the yoke of one plate being above, and that of the next below, and one side of each plate standing between the two sides of the next plate. This appears to be an effort to combine the good features of vertical and horizontal plates, but what the result will be cannot yet be seen.

The Reyneir plate, made by Jacquinot of Paris, consists of a central area of corrugated or folded material, presenting the appearance on each side of a large number of heavy vertical grooves with a central break or aperture.

Chloride accumulators are manufactured by the Society for the Transmisson of Electrical Power, of which Baron Alphonse Rothschild is said to be one of the chief promotors. The distinctive feature of this accumulator is that the active material is composed of chloride of lead. This material is pressed in moulds into little squares with rounded edges, having each a surface measurement of 1¼″. The plates are formed with pockets to receive these squares. The prepared material is gray and easily breaks in the hand.

There is in the Julien exhibit a number of elements consisting of inverted conical hollow dishes, having internal and external ribs and insulated by bands. These dishes carry the active material on their two surfaces. The most remarkable thing about all these accumulator exhibits is that each exhibitor endeavors to establish the absolute failure of all the others. It is also remarkable that all of them have either just

adopted or are about to adopt some new form of plate or radically new improvement which has or will distance all competitors. The inevitable conclusion is that we are still a long distance from the "milk can" period of electricity which is the dream of so many inventors and the nightmare of not a few investors.

Coal vs. Natural Gas.

Dr. J. S. Newberry, of the School of Mines, Columbia College, N. Y., recently published the following arguments respecting the origin and future of coal and gas:

All the oil and gas wells known are located in sedimentary rocks, and hold close relations to great stores of carbonaceous matter derived from organic tissue, vegetable or animal. For example, the oil and gas wells of Burkesville, Ky., Lima, O., Enneskillen and Collingwood, Canada, derive their supply from bituminous shales and limestones of Lower Silurian age. The wells of West Virginia, Pennsylvania, and New York draw their oil and gas from underlying bituminous shales belonging to the Devonian system. The oil wells of Mecca and Grafton, O., are located in the Berea grit, which overlies a stratum of bituminous shale of Lower Carboniferous age. The oil wells of Colorado are sunk into a great mass of bituminous shale in the Cretaceous system. Gas and oil springs are everywhere found along the outcrops of these carbonaceous rocks, but not beyond the area they occupy, and wells bored through them get no oil or gas except in or above them.

No oil or gas wells exist in areas underlain by crystalline rocks, such as New England, the Allegheny belt, the Canadian Highlands, the Rocky Mountains, and Sierra Nevada, because here the carbonaceous rocks have been metamorphosed and their volatile constituents driven off, the residual products of nature's process of distillation, graphite, anthracite, graphitic, schist, etc., alone remaining. In such districts the rocks are broken up and the descent of surface water facilitated. If Mendelieff's theory was true these regions of crystalline and disturbed rocks should be just the places where gas and oil wells would abound; but none are anywhere known so situated.

Volcanic districts where the earth's crust is much broken up and water descends in such volume to zones of heated rocks that steam becomes one of the most important factors in volcanic eruptions should be the places where the production of petroleum and hydrocarbon gases from inorganic materials should take place on a grand scale, but no gas or oil springs or wells are known in such districts.

The history of the petroleum industry has shown that every oil well has but a limited term of service and every oil basin will be exhausted in a period of time proportioned to the number of wells sunk. So the centers of oil production have been migratory, the oil men finding "fresh fields and pastures new" to keep up the supply, but leaving barren territory behind them; barren in this sense, that the current production of oil is so slow they could not afford to wait for it. It has been found by experience that around exhausted wells oil accumulates again, and at Mecca, O., the old wells are pumped for a few days in the year, the supply being regularly renewed, but the quantity is small, and the oil would not be worth collecting except that it is of peculiar value as a lubricator.

Gas and oil are so associated in their modes of occurrence that what has been found true of one may be predicted of the other, viz., that every gas well will have a limited term of service and the great gas reservoirs will be exhausted with a rapidity proportioned to the number of wells sunk.

From this we may infer that oil and gas are not likely to supersede coal or diminish its value. It is true that the great sheets of carbonaceous shale which underlie Western Pennsylvania contain ten times as much combustible as the overlaying coal measures, but except the relatively small quantity of hydro-carbon distilled from the shales in nature's laboratory this store of combustible is beyond our reach. Possibly we may utilize some of the bituminous shales along their lines of outcrop by distilling oil and gas from them by cheap artificial methods, but that is a possible industry that lies in the dim future. Nearly all our 200,000 square miles of coal can be and will be worked out, and are to furnish the means by which the United States is to become the richest and most powerful of the nations of the world. We cannot overestimate the value of this great store of force that is to be made obedient to man's will, and the danger is that we shall overvalue it and continue the wasteful processes of mining and using that we are now guilty of.

And yet the use of petroleum and gas for fuel and light have proved such a convenience that they are destined to modify and greatly improve our methods of coal combustion. The methods by which we now utilize the power contained in coal not only entail a great loss, but fill the atmosphere of our cities with smoke that makes life a burden; and I do not hesitate to say that within the next decade a complete revolution will take place in our method of using soft coal. It will be brought to the vicinity of our cities and manufacturing centers and there be distilled and converted into gas and coke, and in these forms it will be distributed and burned. In that way a great saving of fuel will be effected, and the smoke nuisance be abated.

Economy in Fuel.

The London *Mining Journal* says there is no industrial movement more definitely developed at the present time than that which has for its object the diminution of expenditure upon the important requisite of fuel. This movement extends in two directions—in the first, the object is to decrease the consumption of coal; in the second, to provide a cheap and efficient substitute for that nearly universal form of fuel. At first sight it would appear that both these objects are directly at variance with the interests of the coal owner. This, however, is not so. As Mr. Price Williams has recently pointed out, our coal measures are being subjected to a process of exhaustion, which, having regard to the importance of the interests affected, may almost be called alarming. Posterity, as has been somewhat superfluously said, has done nothing for us, and the coal owner is not called upon to specially concern himself with the fate of future generations, whose means of heating and of motive power may not impossibly be quite independent of any fuel whatever. But when the exhaustion of our coal deposits becomes a question of tens of years in some districts, and of only a couple of centuries in the most favored of them, the question of fuel economy becomes a matter that, after all, cannot be lightly relegated to the consideration of posterity. It is by no means certain that the rapid rate at which our coal supplies are at present being exhausted is altogether advantageous to the mine owner. It involves a comparatively speedy extinction of his property, and it inevitably reduces its commercial value. If the adoption of means for economizing coal or of utilizing other fuels were to occur extensively there is no doubt that the coal mining trade would gradually adapt itself to the change of conditions involved in such a development, and that means would be found to provide for the loss of profit attendant upon a considerable decrease of production. No one can doubt that at present an enormous amount of coal is wasted in the metallurgical and other manufacturing processes of the country—that a large volume of potential power is lost, literally in smoke. The person who said that coal would never be cheap in England until it was 4*l.* per ton had an acute perception of our manufacturers' liability to that serious blunder—the waste of fuel, and consequently of power. If by improved methods of consumption a large proportion of the industrial value of coal were generally utilized the mine owners ought certainly to benefit somewhat from the increase in the usefulness of his product. In any case he could scarcely lose, and must at all events share in the general advantage provided by the addition of an important factor to the efficient equipment of the country for industrial prosperity. Such a result must follow especially upon such a process as that recently described by the President of the Chemical Society—a process which makes the valuable commodity ammonia a product of the combustion of coal, and is also claimed to provide a means for achieving that El Dorado of the scientist—the production of electrical force direct from coal. There is not, of course, any early probability of any widespread diminution in the consumption of coal as fuel, but there is undoubtedly a general tendency towards the economy of fuel which may in the future achieve that end. Perhaps the most desirable consummation which is likely to result from the operations of this tendency is the utilization of waste products in coal such as that enforced by Mr. Mond before the Chemical Society. Advances of that sort mean an important addition to the wealth of the country, not only because of the increased value which they give to coal as a commodity, but because they provide a means of reducing the cost of industrial production generally.

A time of trade revival, following upon a period of commercial depression, is precisely the time best suited to the initiation of new schemes for adding efficiency and reducing cost in the processes of manufacture. While experience recent enough to be well remembered urges the necessity of progressive adaptation to the exigencies of trade, current prosperity provides a stimulus to the increased expenditure which is an essential condition of improvement in productive methods. One of the means of fuel economy in which this fact is strikingly demonstrated is the distribution of power. Largely augmented attention is now being given in various parts of England to the possibility of reducing the expense of motive power by instituting systems for its transmission from a central source. The *raison d'etre* of such enterprises is, of course, the economy

in fuel consumption which is obtainable by producing power at one large establishment and sending it thence to individual users, as compared with its generation separately in each case. The gas engine is really one means of utilizing this possibility. In London transmission of power is largely accomplished through hydraulic mains; in Birmingham compressed air is now being used, and it is not too much to say that we shall see electricity employed, especially in mines, for this purpose. All this, of course, is no menace to the steam engine, which has qualities, especially for large powers, that render it superior to any likely competition. But this centralization of power is a noticeable and an extending industrial expedient, and it is an important feature in the movement towards fuel economy which we are now considering. That the advantages which chiefly recommend this system are rather efficiency and convenience than diminution of coal bills, does not affect its value as a factor in such economy, for it undoubtedly leads to a multiplication of motors without a corresponding increase in the consumption of fuel. It is impossible to touch upon this subject of fuel economy without referring to one phase of it which has the proud distinction of having been the subject of a financial "boom." It is rather difficult to pronounce with any confidence upon the prospects of water gas. There are not wanting authorities who affirm that water gas is deficient in heating power, that it is so dangerous in use as to be scarcely a practicable fuel under any but exceptional circumstances, and experience with it in the United States has been disastrous. Such statements lose some force from the circumstance that they are generally made by persons whose interests would be injured by the extensive adoption of water gas. The gas has undoubtedly been used with remarkable success in several metallurgical concerns—of its practical efficiency under such circumstances we have ourselves had sufficient ocular demonstration—and its employment has been justified by the convincing logic of a heavy decrease in the cost of production. On the other hand, there is some reason to believe that the nature and properties of water gas are not yet properly understood, and that its adoption under ordinary circumstances is scarcely advisable or desirable in the present stage of its development. The investigations which have produced such brilliant results in certain instances are being continued, and the success of the past seems to afford reasonable hope for the achievement of similar results in the future. For the present, water gas seems likely to be confined to use for industrial purposes—a sphere, however, of enormous importance, and in which its value seems to us to have been clearly demonstrated. As to American experience in the use of this fuel, there is ground for believing that English practice is an improvement upon that of the United States in this respect, and, moreover, water gas is still largely employed in the States for heating metallurgical and other furnaces.

It is nearly certain that in the fuel supply of the future, oil, and gas made from oil, will occupy a most important position. The employment of oil gas for lighting purposes has made great strides of late, and it is certain that similar results will attend its exploitation as a fuel. So vastly has the demand for petroleum increased that the great oil fields at Batoum are now said to be rapidly becoming exhausted, and there is some talk of the imposition by the Russian Government of an export duty upon the product. This circumstance of the threatened cessation, or considerable diminution, of the supply of oil from the Caspian is of some special interest for English investors. Skilled geologists declare that the world's natural gases and oils—its hydrocarbons, as they are called—will provide the human race with combustible material for untold ages. But at present the world's resources in this respect have been very little utilized, and it appears that a very considerable proportion of them is contained within the limits of the British Empire. A recent report to the Indian Geological Survey remarks that when European capital and measures are applied the oil fields of Upper Burmah will yield twice as much as they do at present. In other parts of India, in Canada, and in South Australia, there are other large deposits of petroleum as yet undeveloped.

An export tax upon Russian oil might have the effect of considerably stimulating the application of British enterprise in this branch of mining—a branch of which the exploitation has already been commenced, although upon a somewhat unambitious scale. The possibilities of liquid fuel no one can now refuse to admit. Upon one English railway a system of oil-firing has been recently experimentally applied to three classes of engines with a considerable degree of success. In some parts of India and Russia and in Pennsylvania locomotives which burn petroleum instead of coal can scarcely be accounted uncommon. In many of the iron works of the United States artificial oil gas is actually taking the place of that once highly-vaunted fuel, natural gas. In Pittsburgh crude oil has lately been used in the heating of a puddling furnace, with results which are said to arouse the conviction that that fuel is about to play an important part in future manufacture of iron. The combustion of the oil in an apparatus specially designed for its employment, is said to produce a flame which possesses all the intensity of a natural gas flame. It has, however, the advantage of not possessing the intense dryness of the latter, which, as it burns out the cinder in the iron, has some disadvantages as a metallurgical fuel. There seems every reason to believe that the use of oil fuel would become general among the American ironmasters were it not for the matter of price, in which respect it compares unfavorably with coal. Surveying the facts which we have quoted—facts only representative, and by no means exhaustive—the observer must become convinced that a considerable struggle is proceeding between coal and its competing fuels. On the one hand inventions are being made for increasing the cheapness and efficiency of coal, and, on the other, the general adaptability and the commercial value of the other fuels are becoming more and more extended. In the face of the important modifications which are taking place in the character of mineral oil and its products as fuel, and in the face also of the enormous extent assigned by geologists to its deposits, it may be questioned whether we shall not in the early future see a large increase in its production. This is a contingency which cannot but have immediate interest to mine owners and metallurgists, and to those associated with their industries.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Poughkeepsie (N. Y.) Gas Company will connect its low and high level holders with an independent 6-inch main. Quite a boom in gas stoves is reported from Poughkeepsie this summer. In fact Superintendent Tracy, who a year or so ago was inclined to pooh! pooh!! the idea that cooking by gas could be popularized in his locality, is fast becoming an enthusiast on the subject. He ought to have such leanings, when it is known that a week hardly passes now without an order for a cook stove from some converted Poughkeepsie housekeeper.

MR. ELLICE-CLARK, M. Inst. C.E., last year's President of the Association of Municipal Engineers, of Great Britain, and who has been associated with Mr. Valon in introducing oxygen into gas works, left England, in the steamship Servia, on the 21st inst., with a view of introducing the oxygen process into gas works in this country, and also to exploit the Brin process for the separation of oxygen from the atmosphere. Mr. Clark also brings to this country the latest form of Lucigen lamp for burning waste and refuse oils, which is automatic in its action, and has proved quite successful in England.

WE understand that the local authorities have granted to American applicants the right to operate a gas works in Nicaragua. The grant is to be an exclusive one for a period of 15 years.

AFTER the conclusion of the lengthy argument before Judge Bingham respecting the right of the Commissioners to grant another electric light franchise (with the right under it to disturb the streets and to bid for and carry on a portion of the public lighting) for Washington, D. C., his Honor reviewed the evidence and rendered a decision—our readers no doubt remember that these proceedings were in the nature of prayers for injunctions brought by certain citizens and the Washington Gas Light Company. In summing up the matter Justice Bingham said that the question at issue was a very important one and not of the easiest solution. If this were the court of last resort he said he should feel it to be his duty to take the matter under advisement in order that some of its details could be more fully considered, and then went on to say (in substance) that as it was, however, it was not to be expected that matters should be so exactly weighed as in a final hearing. There were two propositions in the case. One was whether the Commissioners had the power to grant to a company the right to put electric wires underground for the purpose of lighting the city or a portion of it. Of this he had very serious doubts, as he was strongly impressed with the fact that Congress had intended to hold the entire matter of lighting the streets in its own hands. He was confident that the taxpayers had the right to bring a suit against what they considered an improper expenditure of money, and the time to do so was before the money was paid out. The status of the Washington Gas Light Company, however, was somewhat uncertain. He was unable to tell whether they had a contract or not that would allow them a remedy at law. He therefore dismissed the injunction suit of the latter and granted that of the former. Of course, there seems but little use or reason in disputing the rendered decision of a Judge, but it would seem that if certain citizens may legally hope for and receive a restraining order to prevent the improper expenditure of

public money, a corporation which has been authorized to carry on certain public work for a stated period of time—and this the very work that upon an interference with which hinges the suggested "improper expenditure of money"—is equally entitled to a restraining order. In fact we do not think that the Justice gave due weight to the showing made by Mr. Webb (of counsel for the Washington Gas Company) who, in closing the case, instanced the fact that one of the specific provisions of the franchise given the Company in 1848 was to the effect that it was to illuminate the streets of the city. In the subsequent acts by Congress amendatory of the franchise that provision had not been abrogated nor even altered. In fact in the act of Congress providing for the public lighting of the District in 1889 it is stated that the sum of money set aside for the purpose ($115,000) was to be used for gas and gas alone. We look for a reversal of the Bingham decision when the matter shall have been passed upon in a superior court.

THE fuel gas speculators have descended upon the Appleton (Wis.) Common Council. The attack does not differ in any way from those that are now most in favor in the West. The applicants—Messrs. Edward D. Cornings and Charles Housell—merely ask for an ordinance authorizing them to construct, operate and maintain a gas works in the city. They assert that it is their desire to furnish a superior article of fuel gas at a rate not to exceed 40 cents per 1,000 cubic feet, and that they propose to employ the system now in use at Jackson, Mich. These gentlemen have assured the Council that they can manufacture this gas for 10 cents per 1,000 cubic feet, and that another dime will cover all charges for distribution, etc. Under the circumstances we fail to understand why they can expect a favorable reply from the Council, for it would seem to us that 100 per cent. profit is somewhat too great. The application was referred to a special committee, composed of Aldermen Conway and Saecker and City Clerk Morgan.

MR. J. D. SULLIVAN, Chairman of the Committee on Lights, Lynchburg, Va., advertises for proposals for lighting the city by electricity for two years—with the the privilege of five—from December 10, 1889. The lowest number of lights to be estimated on is 140, but bidders are given to understand that they shall also state explicitly what charge will be made per light for all over that number that may be required from time to time as the Council shall order in response to public demands. The light is to be of the arc type, of not less than 1,500-candle power per lamp. The competition is to close at noon of Tuesday, October 1. A careful study of the specifications leads to the belief that these were framed in the hope and belief that the award shall eventually be made to a concern known as the Piedmont Electric Illuminating Company.

IN our last brief mention was made of the incorporation, at Council Bluffs, Iowa, of the Council Bluffs Gas and Electric Light Company, by Messrs. Chas. E. Easton, of New York, and Walter S. Wright, of Chicago. The Hon. George F. Wright, of the old Council Bluffs Gas Company, when asked if he were informed as to the personality and objects of the promoters of the opposition movement, replied that he was not, although he thought that the Walter S. Wright mentioned was the same party who had an interest in the fuel gas project at Omaha, Neb. He did not think, however, that they could trouble his Company seriously.

MR. WAGNER, Director of the Philadelphia Board of Public Works, says that the Bureau of Gas will this year yield a profit to the city of $750,000. He also notes that the "privileges granted for nothing by councils to the electric light companies are cutting into the use of gas in the central portions of the city, and if it were not for the increase in the consumption of gas in the outlying wards the department would fall behind in its receipts."

THE ordinance authorizing the Quaker City Fuel and Gas Company to construct gas works and to enter upon any street or highway in the 24th or 27th wards of Philadelphia, to lay and maintain pipes and services for the distribution and conveyance of fuel gas, was discussed at length at a recent meeting of Philadelphia Councels. Mr. Smithers moved a postponement to a named date, which was opposed by Mr. Zane, who thought the measure ought to be rejected on the ground that it gave a private corporation the right to tear up the streets whenever it so wished. It was finally agreed to make the bill a special order for the first meeting in October. The President of the Quaker City Fuel Gas Company is Jno. S. Davis, a prominent politician of Philadelphia, and others interested in it are: The Hon. Mr. Bingham, H. C. Pettit, Edward T. Steel, Hamilton Disston, and F. B. Hays.

THE arrangement for the public lighting of Alexandria, Va., by electricity, are about completed. It was presumed that the work would be begun about July 4, but the contractors were most dilatory in the prosecution of the task assigned them. Better late than never!

THE City Council has made a contract for the lighting of the city for the ensuing twelvemonth with the Red Wing (Minn.) Gas and Electric Light Company. The rates are unchanged, although the authorities made strenuous efforts to secure a concession.

CHARLES CARPENTER, an electrician who resides at Minneapolis, Minn., claims to have perfected a system of cooking food by electricity that may be employed with satisfaction on any desired scale.

MR. C. M. KELLER, of the Columbus (Ind.) Gas Light and Coke Company writing under date of the 13th inst., says: "I to-day send you a copy of the Indianapolis *News*, so that you may see what that paper thinks of a gas superintendent. It is hard, but will have to take. This editorial squib shows to me just what kind of a being the Editor of the *News* must be. It is with him evidently 'anything to beat Grant,' the latter of course meaning the Gas Company." The squib referred to by Mr. Keller is appended: "One of the best wards in Indianapolis represented in the City Council for 10 years by the Superintendent of the Gas Company! Is not that a shame? Would not any citizen of whatever city feel that he was telling a shameful thing to have to say that?" Well, Mr. Editor, apart from the queer verbiage chosen to express the sentiment and query, we have only to say that if every ward in Indianapolis had been represented in the City Council by men whose probity and courage were equal to those manifested by the gentleman so sneeringly complained of, Indianapolis would be one of the best governed cities in the world.

THE authorities of Chicago are complaining of the obstacles "thrown in their way" since they took into their own control the equipment and maintenance of the gasoline lamps used in illuminating the streets of the suburbs. The "troubles" are merely infringement suits instituted by the owners of the gasoline burner patents against the authorities, the latter evidently thinking that they could do about as they liked in the matter of appropriating other peoples property—without paying anything therefor.

SECRETARY PETERS, of the Saratoga (N. Y.) Gas and Electric Light Company is our authority for the statement that the recent failure of the works to supply gas to the residents—the intermission lasted for perhaps an hour—was occasioned by a defective seal in the purifying department.

IT IS said that the proprietors of the Kansas City Gas Light and Coke Company have determined to adopt the inclined system of retorts in their installation, to be made next Spring, on the site purchased some months ago for their new works. The Company's new gasholder—calculated capacity, 1,000,000 cubic feet—will be completed in time to be availed of during the coming winter season. The tank excavation was made in very treacherous ground, and the ingenuity of the builders was taxed to the utmost in meeting the varying conditions. The tank bottom rests on a foundation that absorbed 1,000 heavy piles.

TWICE within the present month—the "spells" lasted about an hour each time—Allegheny City, Pa., was plunged in darkness as to its streets. The engineer of the electric light works refused to keep the engines in motion because the supply of water was insufficient. Much inconvenience resulted from the stoppages.

SOME weeks ago we noted that the proprietors of the Mutual Fuel Gas Company (Oakland district, Chicago) had purchased a plot at the corner of Fortieth street and Langley avenue whereon to construct their works. As this is close to a very finely built-up residence center, the people in the vicinity took alarm and their fears finally culminated in the appointment of a committee charged with the task of preventing the proposed construction from being carried out. Public meetings for the expression of opinion respecting the affair have been held, and the following resolutions were adopted:

"*Whereas*, It is proposed by a corporation to erect a plant to furnish fuel and illuminating gas on Fortieth street, near Langley avenue; and

"*Whereas*, This is situated in the center of one of the finest residence portions of the city, and the erection of a plant of this sort will necessarily tend to deteriorate the value of property and render the vicinity of the gas works unfit to be used as a first-class residence neighborhood, ow-

ing to the nauseous odors which necessarily result from the manufacture of gas, whether made from gas coal or superheated steam; and

"*Whereas*, This plant is to be erected within a block of the fine churches attended by the people of this neighborhood, and within half a block of the Oakland school, and between Grand and Drexel boulevards, and close to Oakwood boulevard, be it

"*Resolved*, That it is the sense of the people of this vicinity that it is our duty to exhaust all legal means to prevent the consummation of this outrage." The following gentlemen have been named as committees on finance and action to follow up these conclusions by means of legal steps: Maj. Allen, Gen. Smith, and Messrs. W. H. Rand, Geo. Woodland, W. B. Clark, C. C. Landt, A. F. Murray, W. H. Colvin, E. B. Sherman, Henry Trumbull and J. L. McKeever. It is strange, to say the least, that the projectors of the fuel gas scheme should select a handsome residence locality as the site for their plant, when scores of more eligible sites could be had at much lower figures; that is, it would be strange were the step taken in good faith.

THE Chamber of Commerce Committee, of St. Paul, Minn., some account of whose doings in connection with the gas supply of that city have been reported in the JOURNAL, have about reached a conclusion in this regard. Mr. E. V. Smalley, of the special committee designated to look into the matter of gas charges, reported that the St. Paul Gas Company be urged to charge a uniform price of $1.75 per 1,000. The committee declined to recommend the acquisition by the city of the Gas Company's plant, but submitted that the Company, enjoying as it does a public franchise, should not be allowed to charge consumers an increased price for gas for the mere purpose of increasing its capital and extending its system. The price charged should not exceed the amount required to yield a fair return on the investment over and above working expenses. At this point Mr. Lenau protested against the recommendation of a uniform rate of $1.75. As a manufacturer, using gas as a motive power, he paid only $1.50, and he did not think an additional charge should be imposed on large consumers. Messrs. Baker and Noyes also coincided in this view. This was followed by the introduction of a resolution placing the uniform rate at $1.50, but before it could be acted on it was decided to lay the report over one week, the committee being instructed to, in the meantime, prepare a definite resolution thereon.

THE San Pablo (Cal.) Gas and Oil Company has been incorporated. San Francisco capital controls it.

THE concession recently made by the Danvers (Mass.) Gas Light Company in the matter of the supply of gas for cooking purposes has more than answered the hopes of its champions. The Company's main system is being extended to meet the wants of prospective consumers.

THE new gas rate at Warren (R. I.), which has been adjusted at $2 per 1,000, is also a success. The plant is now in good shape.

THE Forty-First Annual Meeting of the Worcester (Mass.) Gas Company was held on the 11th inst., with the President, Mr. Chas. D. Lamson, in the chair; Clerk Hamilton having charge of the Secretary's desk. The annual report of the President shows that the manufacturing account for the year ending June 30, 1889, is given at a production of 93,989,300 cubic feet of coal gas, and 19,193,000 cubic feet of water gas, or a total of 113,182,300 cubic feet. Of this quantity 101,685,800 cubic feet were sold by meter, and the street lamps took 3,721,400 cubic feet, which puts the leakage and condensation account at about 6.5 per cent. Gas sold in 1889, 105,486,000 cubic feet; in 1888, 92,435,100 cubic feet, or an increase of about 14 per cent. Coal used in the manufacture of gas, 8,420.5 tons; coke used in the production of water gas, 14,502 bushels. coke sold, 136,245 bushels. The candle power of the gas averaged 18.3. The State Inspector has given the Company credit for an increased candle power during the past six months; 1,134 meters were set and 798 were removed, leaving the total number in use on July 1st 4,192. The report speaks highly of the new gasholder. A new retort stack of 6 benches of 6's has been arranged for, and an underground brick tank for the storage of ammonia water was constructed. During the year the extension of main pipes amounted to 20,869 feet, and 2,818 were removed. A new 10-inch pipe was laid from the works to Washington Square, which gives the Company ample pressure in the business portion of the city. The net gain in services was 119. The number of gas stoves in use is returned at 850. Comparatively few Lungren burners have been sold in Worcester, the preference seemingly being in favor of a device known as the "Arc Regenerator" gas burner. The late President, Dr. Joseph Sargent, was referred to in fitting terms. The services of Mr. Samuel Woodward, also a member of the Board, who died during the year, were appropriately and feelingly commented on. A quarterly dividend of 2 per cent. was then declared, payable on October 1st. The election for Directors resulted as follows: Chas. D. Lamson, A. G. Bullock, J. E. Davis, Waldo Lincoln, J. H. Clarke, F. H. Dewey and Joseph Sargent. Mr. Sargent succeeds Mr. Calvin Foster, resigned. The Directors subsequently chose the following officers: President. Chas. D. Lamson; Clerk and Treasurer, Jas. P. Hamilton. From the above it will be seen that Mr. Chas. D. Lamson has fulfilled to the last and best degree the opinions put forth by us at the time he was chosen to succeed the lamented Dr. Sargent in the Presidency of the Company; and that he will continue to lead the Company ably is beyond denial. We tender him our congratulations on this, his first official showing respecting the trust that he is so competent to guard.

THE Trustees of Greenbush village (N. Y.) seem at last to have solved the problem of the public lighting of that place. In any event at a recent meeting of the Board it was decided to award the contract to the East Albany Gas Light Company—incandescent electric lights to be employed—for a period of 5 years, the Trustees reserving the right to at any time substitute arc lights for those now called for in the contract. The contract rate is $3,600 per year.

THE Greenville (Texas) Water and Light Company has been incorporated by Messrs. S. W. Fordyce, R. C. Kerens, Thomas Howard, Jno. W. Harrison and F. B. Nichols, of St. Louis, Mo., and J. M. Cook, E. B. Perkins, Thos. King and J. D. Lasater, of Greenville. The officers are: President, J. M. Cook; Vice-President, E. B. Perkins; Secretary and Treasurer, F. B. Nichols.

MASSACHUSETTS maintains what is known as a Board of State Police, and their duties seem to be in the nature of an irresponsible smelling committee, while their actions are often of the kind allied to buncombe. Having taken it into their heads that the health of workmen who were obliged in certain factories to use irons heated by gas was being injured, the "police" instituted an investigation. So far, however, the investigators have met with small comfort; for many of the workmen declare that their labor has been rendered much more pleasant since the introduction of gaseous fuel into workshops of the class where many irons are used.

THE proprietors of the Ilion and Mohawk (N.Y.) Gas Light Company have determined to substitute a 6-inch main for the 4-inch specimen that has been doing duty in Main street for years past. The main is to run from the gas works to a point on Otsego street, close by where the Baptist church stands. This increased service will benefit the Company greatly. It gives us pleasure to add that the Gas Company is one of Ilion's institutions which does not stand still.

THE Brunswick (Me.) Gas Light Company is making important main extensions.

AT a recent meeting of the Directors of the Keene (N. H.) Gas Company it was determined to consolidate the berths of Treasurer and Superintendent. Mr. George M. Rossman was then appointed to the dual office. Mr. Wallace L. Mason, of the Keene National Bank, had acted as Treasurer of the Company since 1887, but could not make it convenient to keep up with the duties involved, owing to pressure of other demands on his time.

THE Providence (R. I.) Gas Company will pay a dividend of $1 per share on October 1st.

THE Indiana Water and Light Company, of Shelbyville and Warsaw, Ind., has been incorporated by Messrs. B. B. Ludwig, C. Mann, J. Greely, K. M. Hord and E. M. Adams. It is capitalized in $250,000.

PURSUANT to the petition of the Mutual Gas Light Company, of Savannah, Ga., submitted some time ago to the authorities, asking for the privilege of bidding to light the city with gas or electric light, or both, the Clerk of the Council (Mr. Reburer) has been instructed to advertise for bids for lighting the city for a series of years, from January 1, 1891, the competition to close on October 15. The Brush Company now has the contract, which does not expire until January 1, 1891. As we understand it, the proposition is to ask for bids for 50 arcs or 250 gas or incandescent electric lights, for one year from January 1, 1890, to January 1, 1891—this not in any way to interfere with the Brush Company's con-

tract, but merely to make provision for increasing the present public lighting to a degree commensurate with the growth of the city. At the same time bids are to be asked for on the basis of 200 or more arc lights, to cover the city, for periods of 2, 3, 4, 5 and 6 years, respectively.

"THE Chelsea (Mass.) Gas Company evidently has much to contend with in the pronounced disfavor in which it is held by some of the local authorities, a disfavor that has no basis on proper ground, so far as the service rendered by the Gas Company to the city and the citizens is concerned. Some time ago the Gas Company was awarded a contract for a mixed system of gas and electric public lighting, and was obliged under it to make provision for an electric installation. Unavoidable delays on the part of those who were to furnish the Company with certain apparatus put back the completion of the work, which was seized as a pretext for a tirade in Council by the enemies of the Company. The following report of the proceedings at a recent special meeting of the Council (held on 12th inst.) may be of interest to your readers, whose knowledge of reading between the lines will reveal the animus of the Company's opponents. The proceedings were opened by the offering (by Ald. Martin, of the Street Lighting Committee) of the following: '*Resolved*, That in consequence of the great delay, from incompetency or inability of the Chelsea Gas Company to complete the contract for lighting this city with electric lights, and as 60 days have expired over the time for the *completion* of said contract, and the committee on street lighting have been promised from time to time that the work should be completed within a certain number of days, that the Gas Company has failed to fulfill said promises to the great detriment of the best interest of our city, that the committee on lighting streets be instructed, in case the said Gas Company does not, within a reasonable number of days in the judgment of said committee, complete the electric lights for the city, as per contract, they, the said committee, cause action in damages to be commenced against said Gas Company, and to cancel the contract for non-fulfilment. *Resolved*, That the said committee on street lighting take into consideration and report the probable cost to the city to put in an electric light plant of its own and ascertain if the city has not the right under the new law to use without expense any poles, now set in the city, for its own purposes.' Ald. Martin, in support of the preposterous resolutions, made a very weak argument. He was followed by Ald. Kimball, who urged that the Gas Company was making every reasonable effort to complete the contract, and submitted in support of this belief that the Company actually was, despite the difficulties that beset it in the carrying on of the work, furnishing nightly 98 arc lights—or about two-thirds of the number the city desired to maintain. The resolutions (having passed the first reading) were finally laid over until the next meeting of Council. There can be do doubt about it that certain members of the Council have irons of their own which they would like to have heated without expense to themselves.—OBSERVER."

THE article on "Sidero-Cement Pipe," which was given on page 378 of our last issue, originally appeared in *The Engineering and Building Record*. By-the-way, the title of this publication has not been altered for some months.

IT IS reported that the Laclede Gas Light Company, of St. Louis, has secured control in the United Electric Light Company, of that city. It is a most important move, for with its accomplishment the Laclede Company is in control of the gas and electric lighting business of the city. Verily, McMillin is a great organizer.

THE official tests of the gas supplied by the Cartersville (Ga.) Gas and Water Company to the public lamps show the candle power of the same to be 30 per cent. in excess of the value required under the contract. We might also note the queer fact that the Mayor and Board of Aldermen of Cartersville, in acknowledging the good quality of the gas, conclude their presentation of the case in the following manner: "We trust our citizens will give the Cartersville Gas and Water Company the patronage it deserves!" General Manager Blaisdell and Superintendent Miller are to be congratulated on the temper of the local authorities.

THE Sioux City (Iowa) public lighting contracts have been ratified. A mixed system (gas lamps and arc lights) is to obtain.

THE New Bedford (Mass.) Gas Company will extend its electric lighting service to Fairhaven.

A FORTNIGHT ago we reported the resignation of Mr. Wm. A. McEwen, as Secretary and Treasurer of the Capital City Gas Company, of Des Moines, Iowa, in order that he might attach himself to the home office of the United Gas Improvement Company. The date fixed for his departure to Philadelphia was the 13th inst., and on the day before the retiring official was invited to meet the officers and employees of the Capital City Company, who, much to his astonishment, presented him with a handsome etching. The presentation speech was made by the Company's Manager, Mr. E. G. Pratt—ex-Secretary of the Guild of Gas Managers. To say that the recipient was surprised and gratified is to write it down as mildly as one may.

THE work of installing the water gas plant on the premises of the Terre Haute (Ind.) Gas Light Company is well under way.

THE Murphysboro (Ills.) Water Works and Electric and Gas Light Company has been incorporated by Messrs. George Kennedy, Jr., Willard Wall and George W. Hill.

W. A. ROBINSON, of Atlanta, Ga., is said to have purchased a controlling interest in the plant and franchises of the Athens (Ga.) Gas Company.

AT a recent meeting of the Allegheny (Pa.) Council, Mr. Stayton, from the Gas Committee, recommended the passage of a resolution awarding the contract for the installation of a municipal electric lighting plant to the Westinghouse Company, at its bid of $141,158.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

What Everyone Expected.

THE JETER & BOARDMAN GAS AND WATER ASSOCIATION,
MACON, GA., Sept. 13, 1889.

To the Editor AMERICAN GAS LIGHT JOURNAL:

The enclosed copies of letters received from the Board of Public Works, Fernandina, Fla., explain themselves. As an item of news, I thought you might like to know that these works were completed. The mains stood the pressure of 210 pounds to the square inch, at which point a lead joint blew out, but no other defect showed itself. They will probably never be put to higher pressure than 100 pounds hereafter.

The citizens were quite enthusiastic, and in the afternoon of the day on which the water was turned on a fire occurred in the jail, and by means of the works they were enabled to save the building with but little damage.

The Brunswick Light and Water Company has just completed a commodious station for their electric light plant on the gas works lot. They will move their present apparatus to that point, and increase the capacity by 50 arc lights. Will probably have all up by October 1st.

The Cartersville (Ga.) Water Works are complete with the exception of the tank on top of the tower. Water was turned on the mains here on the 6th, and the local press is loud in its praise of the water and fire protection.

Will meet you at Baltimore, in October, D. V.

Yours, very truly, A. E. BOARDMAN.

[The enclosures forwarded by Secretary Boardman are appended.]

FERNANDINA, FLA., Sept. 11, 1889.

Messrs. Jeter & Boardman Gas and Water Association, Macon, Ga.: Gentlemen:—We, the Board of Public Works, of the city of Fernandina, Fla., hereby notify you that the water works system that you have constructed have this day been tested and found to comply with provisions and agreements of the contract, entered into March 13, 1889, and we hereby accept the same as satisfactory. JAMES MCGRIFFIN,

Acting Chairman Board of Public Works.

FERNANDINA, FLA., Sept. 11, 1889.

Messrs. Jeter & Boardman Gas and Water Association, Macon, Ga.: Gentlemen:—We, the undersigned, members of the Board of Public Works of the city of Fernandina, Fla., have accepted on this day the system of water works which you have just completed here.

We take great pleasure in expressing to you our appreciation of the zeal and skill with which you have carried out the work—not only in accordance with your contract, but also in the best interests of the city.

Respectfully, the Board of Public Works,

JAS. MCGRIFFIN, Acting Chairman.
B. T. BURCHARDI, Secretary.

THE AMERICAN
GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

EDITOR—Jos. R. Thomas, C.E.
ASST. EDITOR—T. J. Cunningham.
MANAGER—C. E. Sanderson.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 42 Pine Street, New York.

This is a recognized official organ of
LIGHT, HEAT, STEAM, WATER SUPPLY,
VENTILATION, SANITARY IMPROVEMENT,
AND GENERAL SCIENCE

TERMS:
SUBSCRIPTION—Three Dollars per annum, in advance. Single copies, 10 cents.

AGENTS.
NEW YORK.—AMERICAN NEWS CO., 39 and 41 Chambers Street.
PHILADELPHIA—PRATT & CO., Corner Ninth and Arch Streets.
Germany.—B. WESTERMANN & CO., of New York.

MONDAY, SEPTEMBER 23, 1889.

Electric Car Lamp.

The *Scientific American* says that one of the latest novelties in the application of electricity consists of an electric reading lamp, which is being fitted to the carriages on the main line of the Southeastern Railway. It is on the principle of the "put a penny in the slot" automatic machines. The apparatus is situated immediately over the passenger's head, and under the rack, and is contained in a small box 5 inches by 3. The light is of 5-candle power, and is obtained by the introduction of a penny at the top of the box, and by a subsequent pressure of a knob, and will last for half an hour, extinguishing itself at the end of that time automatically. If the light be required for an indefinite period a penny every half an hour will suffice. The light can be extinguished at any moment by means of a second button provided for the purpose. One of the special features of the invention is that, if the instrument is out of order, the penny is not lost, as it is in the present machines. It drops right through, and comes out at the bottom of the box, so that it can be recovered, and the same result happens in the case of any coin other than a penny. Each carriage is fitted with an accumulator which supplies the electricity. This invention, so *Nature* says, will add greatly to the comfort of passengers during night journeys.

The Market for Gas Securities.

The market for city gas shares was fairly active during the week, Consolidated having sold up to as high as 89¼. To-day (Friday, Sept. 20) 89 is bid, with no stock offering. The tone, however, is strong. The Equitable Company has declared a regular quarterly dividend of 2 per cent., payable October 15. Mutual is stronger, with a fair prospect for a good improvement. The following securities were sold at auction: 33 shares Mutual gas, at 103½; 54 shares Nassau gas (Brooklyn), at 113½; 15 shares Williamsburgh gas, at 122. Brooklyn shares as a rule are steady to strong, and Washington (D. C.) gas has made an advance. The Bay State syndicate have made a division of their holdings, save a reservation of 33 per cent. which is to go to the Dorchester Company. Chicago Trusts are rather weaker, having sold down as low as 56¾. The stock seems to us to be a purchase at or below 60.

Gas Stocks.

Quotations by Geo. W. Close, Broke and Dealer in Gas Stocks.

16 WALL ST., NEW YORK CITY.

SEPTEMBER 23.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share. ☜

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	89	—
Central	500,000	50	—	—
" Scrip	220,000	—	—	—
Equitable	4,000,000	100	122	125
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	116	118
Mutual	3,500,000	100	102½	104
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	60	70
" Bonds	15,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	107	109
Citizens	1,200,000	20	60	65
" S. F. Bonds	320,000	1000	—	103
Fulton Municipal	3,000,000	100	126	127
" Bonds	300,000		—	106
Peoples	1,000,000	10	75	76
" Bonds (5's)	368,000	—	97	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	88	91
Nassau	1,000,000	25	112	114
" Ctfs	700,000	1000	100	103
Williamsburgh	1,000,000	50	122½	123
" Bonds	1,000,000	—	109	112
Out of Town Gas Companies.				
Boston (Mass.) Gas Co	2,500,000	500	240	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
" " Bonds	45,000	—	—	—
Chicago Gas Trust	25,000,000	100	57¾	—
Cincinnati G. & C. Co.	6,000,000	100	214	218
Consumers Toronto	1,000,000	50	190	200
Central, S. F., Cal.			80	90
Capital, Sacramento, Cal.			58	
Consolidated, Balt.	11,000,000	100	44¼	44½
" Bonds	6,400,000		107	107½
Hartford, Conn	750,000	25	120	130
Jersey City	750,000	20	175	180
Laclede, St. Louis, Mo.	2,000,000	100	140	—
Louisville, Ky.	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	200	208
Memphis (Tenn.) Gas	750,000	100	48	51
" Bonds.	240,000	100	103	—
New Haven, Conn		25	200	—
Oakland, Cal.			35	35½
Peoples, Jersey City		—	60	61
" " Bonds			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	99	100
Syracuse, N. Y.	500,000	25	—	—
St. Louis, Missouri	600,000	50	—	750
San Francisco Gas Co.			60	60½
San Francisco, Cal.	10,000,000	100	59¾	60
Washington, D. C.	2,000,000	20	200	208
Wilmington, Del.		50	200	208

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John McLean, New York City 428
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GAS ENGINES.

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ENGINES AND BOILERS.

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GAS LAMPS.

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GAS STOVES.

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A Six-Inch Isbell's Automatic Street Governor

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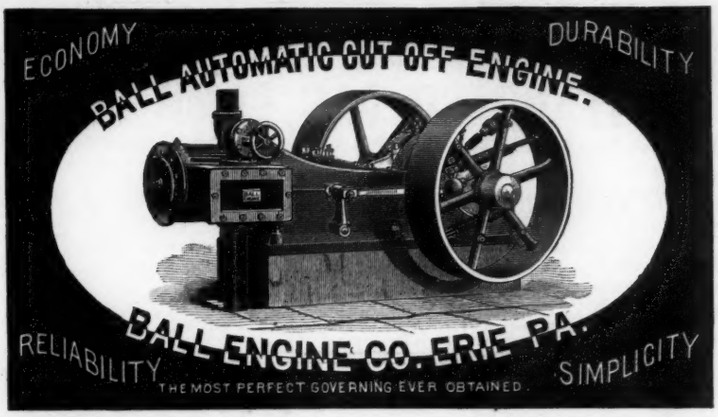

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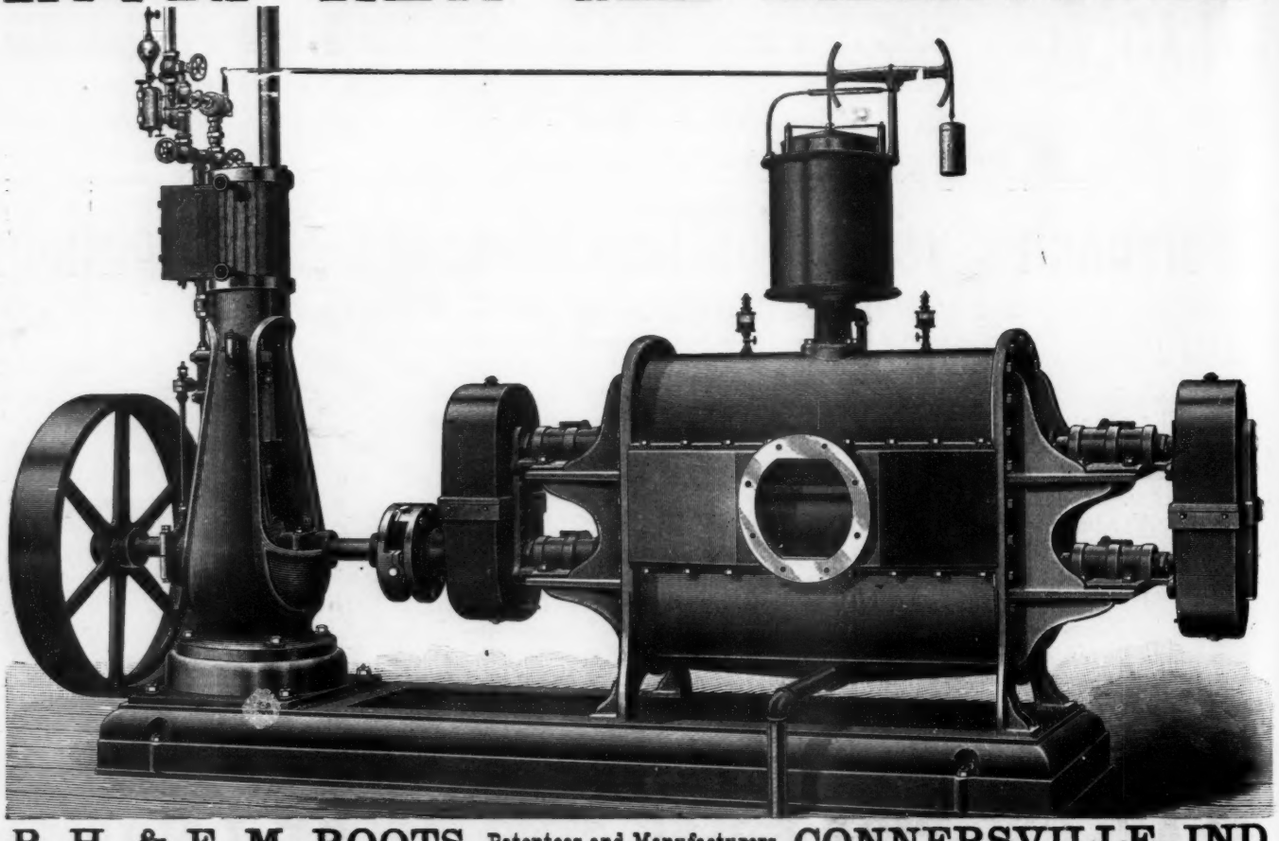

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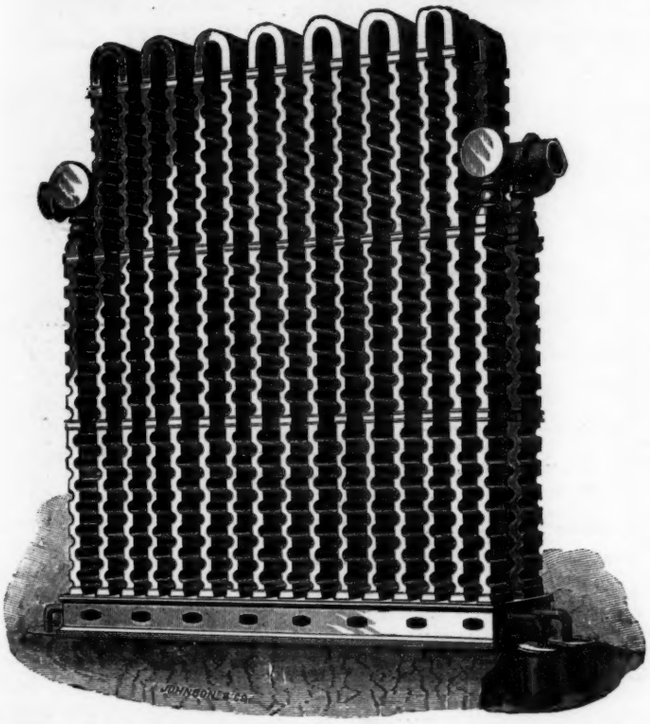

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Gloucester, Mass.	Woburn, Mass.	Attleboro, Mass.	Paterson, N. J.
Newton & Watertown, Mass.	Peoria, Ill.	Calais, Me.	Dover, N. H.
	Clinton, Mass.	Fall River, Mass.	Waltham, Mass.

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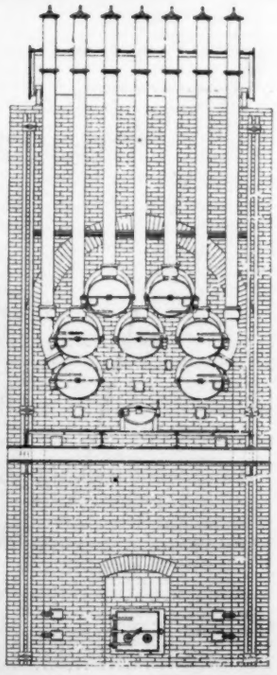

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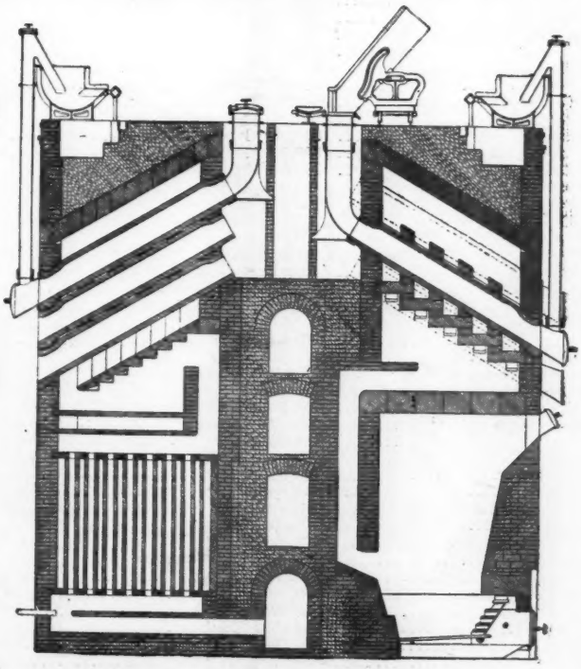

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Erected and in course of construction at present date:

	Capacity. Cubic feet per day.
Altrincham	600,000
Adelaide	600,000
Aldershot	200,000
Allegheny, U. S. A.	1,000,000
Ashton-under-Lyne	1,250,000
Amsterdam	1,500,000
"	1,500,000
Annaberg	200,000
Arcachon	100,000
Animal Charcoal Co	200,000
Altoona, U.S.A.	350,000
Buxton	250,000
Bradford	1,000,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,000,000
"	1,000,000
"	3,000,000
Bremen	150,000
Baltimore, U.S.A.	1,000,000
"	1,000,000
"	1,000,000
Balmain, N.S.W	125,000
Bishops Stortford	150,000
Blackpool	400,000
Brussels	1,250,000
"	1,250,000
"	750,000
"	1,250,000
Banbury	250,000
Birmingham	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
Boston, U.S.A.	2,000,000
Brisbane	1,500,000
"	300,000
Burton-on-Trent	1,500,000
Barcelona	350,000
Barking	100,000
Baerlien & Co	20,000
"	20,000
Bombay	400,000
Buffalo, U.S.A., Mutual	750,000
" " **Citizen**	500,000
Brookline, U.S.A.	500,000
Bergen	350,000
Berlin	1,250,000
Bournemouth	1,000,000
Bridgeport, U.S.A.	500,000
Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
Brooklyn, U.S.A.	1,000,000
"	1,000,000
" " **Nassau**	1,000,000
Brunner, Mond & Co.	400,000
Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A.	500,000
Cincinnati, "	1,500,000
" "	1,500,000
Chicago "	3,000,000
" "	1,000,000
" "	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas Works Co	100,000
Cadiz	300,000
Charlottenburg	600,000
Dudley	750,000
Driffield	100,000
Dukenfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
Derby	1,500,000

	Capacity. Cubic feet per day.
Dublin	3,000,000
Dowlais	100,000
Douai	500,000
Denton	500,000
Derby, U.S.A.	350,000
Denver, "	500,000
" "	1,000,000
Dusseldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z	400,000
Darlington	1,250,000
Detroit, U.S.A.	750,000
Edinburgh	1,500,000
"	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150,000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W	100,000
Grieg	300,000
Georgetown, U.S.A.	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A.	1,000,000
Ilkeston	300,000
Inverness	250,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Konigberg	1,000,000
King's Lynn	300,000

LONDON:—

The Gaslight and Coke Co.:	
Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

LONDON—*Continued.*	Capacity. Cubic feet per day.
Shoreditch	2,500,000
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	560,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A.	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A.	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
Middleton	400,000
Manley, N. S. W	100,000
Minneapolis, U. S. A.	750,000
Magdeburg	300,000
Memphis, U. S. A	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A.	430,000
Newmarket	150,000
Newark, U.S.A.	680,000
Northfleet	200,000
New York, U.S.A.	2,000,000
Nice	600,000
Newcastle, N. S. W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000

	Capacity. Cubic feet per day.
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N. S. W	100,000
Prescott	150,000
Providence, U.S.A.	750,000
"	750,000
Plauen	300,000
"	300,000
Portsmouth	2,500,000
"	2,500,000
Pittsburgh, U.S.A.	1,500,000
Portland, "	560,000
Pawtucket, "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U S.A	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
Rockhampton, N. S. W	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N. S. W	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Josephs, U.S.A	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A.	2,000,000
"	2,000,000
"	1,000,000
Laclede	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A.	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A.	750,000
Toronto	1,000,000
Uxbridge	300,000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston-super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A.	600,000
"	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A.	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A.	500,000
Windsor, N. S. W.	100,000
Wolverton	100,000
Wellington, N. Z.	250,000
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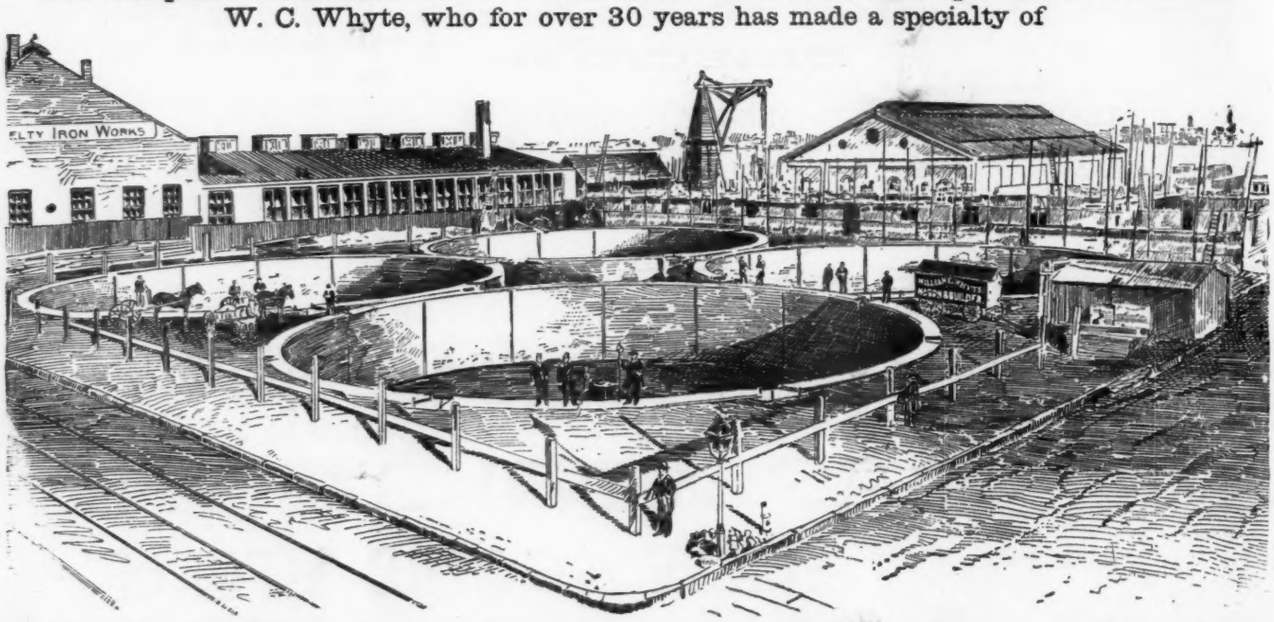

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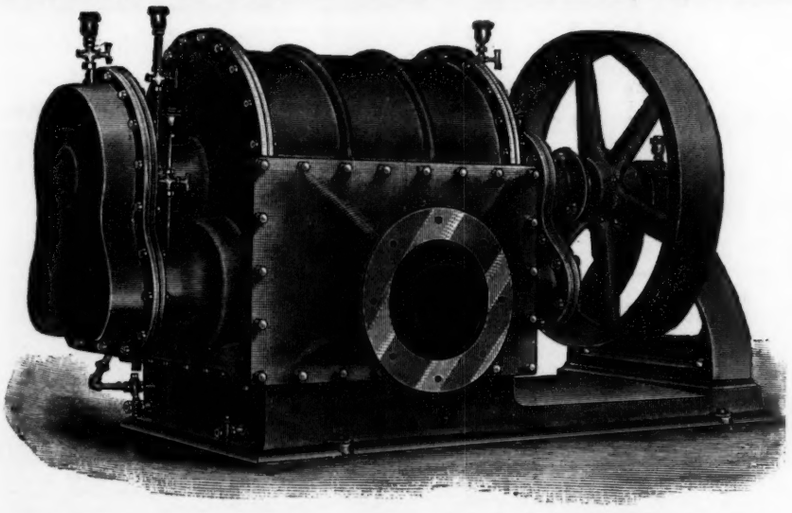

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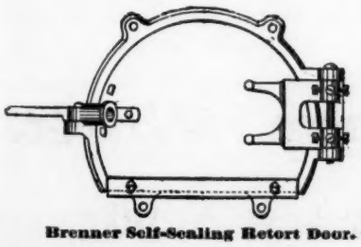

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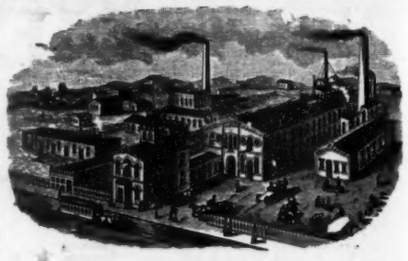

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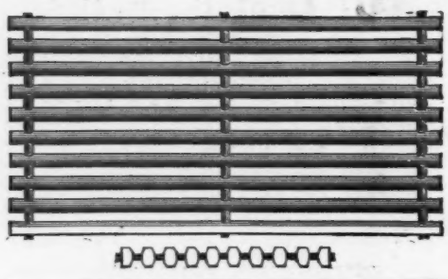

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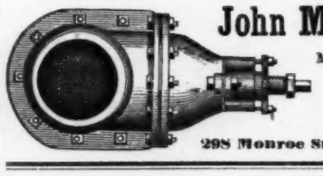

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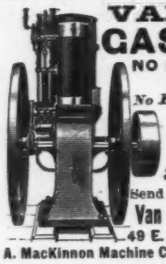

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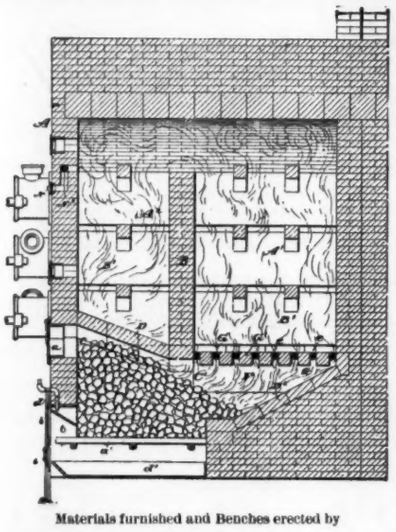

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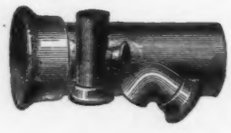

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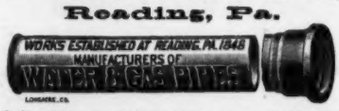

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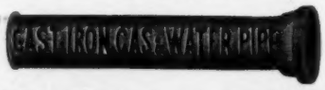

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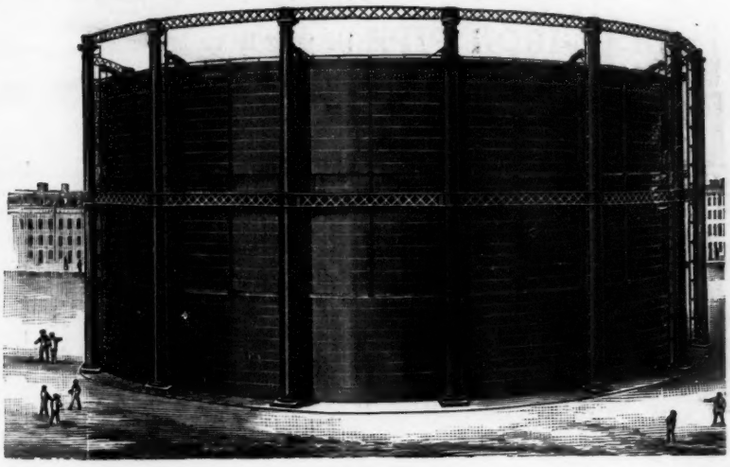

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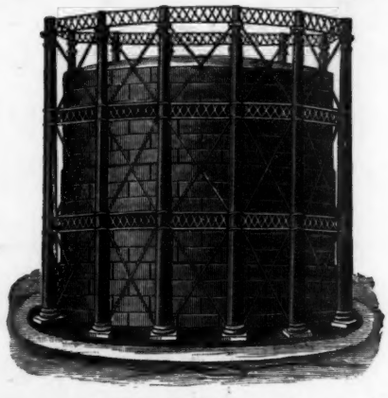

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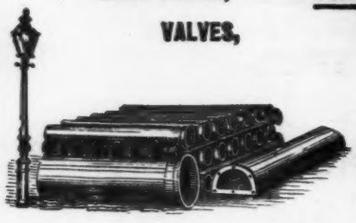

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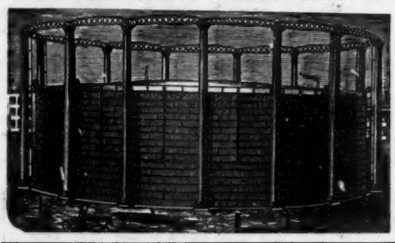

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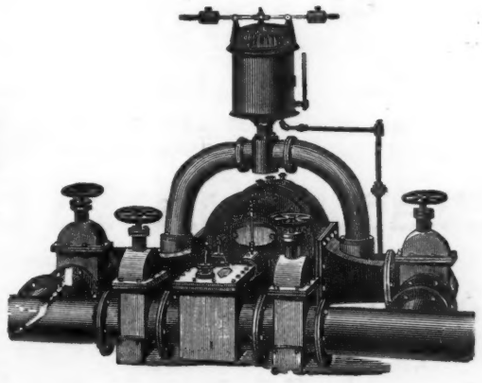

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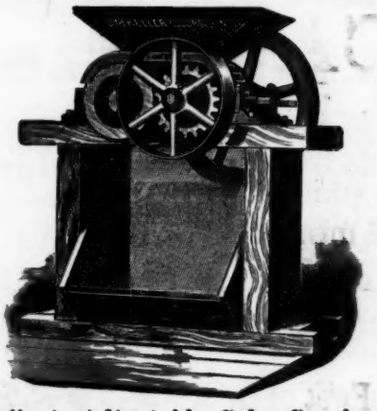

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51 Lancaster St., Albany, N. Y. 34 & 36 West Monroe St., Chicago, Ill.

STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS, PRESSURE GAUGES, ETC.

Also STAR GAS STOVES, RANGES, and HEATING STOVES.

We use only the very best materials, and employ the most skilled labor, and by our long experience (32 years) and personal supervision of every detail, we feel justified in assuring the public that our goods will give perfect satisfaction. Every Meter emanating from our establishment will bear the State Inspector's Badge, and will be fully warranted by us. Our Annual and Calendar will be sent to Gas Companies upon application.

GAS ENGINES. GAS ENGINES. GAS ENGINES.

Gas into Electricity

BY THE

OTTO GAS ENGINES.

Gas Companies are given by the Otto Gas Engine superior means for Production of Power and Electric Light.

In Theory the Otto Gas Engine realizes 18 per cent. actual work out of number of heat units in fuel consumed, while the ordinary steam plants reach but 12 per cent. **In Practice** a comparison of cost in dollars and cents between gas and steam power stands as follows (the figures below being taken from actual experience):

50-H.P. STEAM ENGINE AND BOILER, Running a Plant of Fifty 2000-C.P. Arc Lamps 12 Hours.	
4,500 lbs. Indiana nut and slack, at $1.30 per ton	$2 93
Engineer, one night, at $50 per month	1 67
Trimmer, one day, at $40 per month	1 33
Superintendent or Electrician, one day, at $50 per month	1 66
Waste, etc., one day, at $20 per year	05
Water rent, one day, at $40 per year	11
Wheeling coal and removing ashes, at $4 per week	58
100 pairs carbons, at $18.50 per 1000	1 85
One pint cylinder oil, at 60 cents per gallon	07
One quart engine and dynamo oil, at 50 cents per gallon	13
Total	$10 38

50-H.P. OTTO GAS ENGINE, Running a Plant of Fifty 2000 C.P. Arc Lamps 12 Hours.	
9,200 cu. ft. gas, at 42 cts. per M. (for cost of gas see items below)	$3 86
Engineer not needed; engine is in care of Electrician or Supt.	....
Trimmer, one day, at $40 per month	1 33
Superintendent or electrician, one day, at $50 per month	1 66
Waste, etc., one day, at $20 per year	05
Water rent dispensed with (cooling water used over and over)	....
Handling of coal included in cost of gas	....
100 pairs carbons, at $18.50 per 1,000	1 85
One pint cylinder oil, at 60 cents per gallon	07
One quart engine and dynamo oil, at 50 cents per gallon	13
Total	$8 95

Expenses of depreciation, repairs, and interest omitted, being considered the same in both cases—though depreciation and repairs are much higher with steam on account of boiler and its appurtenances. Cost of gas in the holder we estimate for most of the Middle and Western States as follows: Coal, 30 cts.; labor, 20 cts.; purification, 2 cts.; total, 52 cts. Less coke, 7 cts., and tar, 3 cts.; leaving net cost of gas 42 cts. The items of Superintendence and repairs, being paid for by the gas sold to consumers, need not be charged on extra output for gas engine consumption. Where the cost of gas is higher than here figured, coal for steam use will be found proportionally higher, and final figures of comparison show same amount of saving.

Excess in Cost of Steam over Gas Power is thus $1.43, or nearly 16 per cent.

Coal for getting up steam and banking fires is not included in above figures, and should be added, thus increasing rate of economy of gas power beyond that shown by our figures.

Where Gas Companies adopt Gas Power for Electric Plants, Water Works, Sewerage, etc., they not only choose **the most economical power for their use,** but secure to themselves the **numerous advantages of increased production,** without increase of expense, and benefit thereby their entire manufacture. They induce consumers, by their example, to abandon Steam for Gas Power, and, by establishing special rates, make

Gas Power the Leading Power of To-Day,

AND SOLVE AT ONCE THE QUESTION OF FUEL GAS.

"Otto Gas Engine Works,"

SCHLEICHER, SCHUMM & CO.,

151 Monroe St. (Kent Building), Chicago. **33d and Walnut Sts., Phila.**

NEW YORK AGENCY, 18 VESEY STREET.